ROADS and STREETS

PUBLISHED MONTHLY BY ENGINEERING AND CONTRACTING PUBLISHING COMPANY
221 EAST 20TH STREET, CHICAGO

HALBERT P. GILLETTE, President and Editor — R. W. HUME, Vice-President
E. S. GILLETTE, Secretary — C. T. MURRAY, Managing Editor
FREDERIC KAMMANN II, Advertising Manager

Cleveland Office, 621 Hippodrome Bldg.: E. C. KELLY, Manager
New York Office, 441 Lexington Avenue: ERWIN T. EYLER, Eastern Manager

Subscription Price $2.00 — Foreign Postage 65c Extra

Vol. LXVI — CHICAGO, NOVEMBER, 1926 — No. 5

A New Branch of Highway Engineering —Traffic Control

Specialization, more specialization, endlessly more, seems to be the order of progress. Traffic control engineering is perhaps the latest specialty in civil engineering. It has long had its counter part in the railway field, where signal engineering became so important 18 years ago that a magazine, the Railway Signal Engineer (now *Railway Signaling*) came into existence. That magazine has nearly 5,000 paid subscribers, which gives some idea of the importance of that department of railroading.

Since there are 12 times as many miles of country roads as of railroads, and since motor cars and trucks move with an average velocity exceeding that of the average train, and since there are 20 million motor vehicles, is it not clear that traffic control is destined to become an increasingly important branch of highway engineering?

At first, and even yet in large measure, traffic control in cities was placed under the direction of the police department. This was natural, because in its earliest form traffic control was little more than the blowing of a policeman's whistle on congested streets. But with the advent of signalling apparatus, the evolution of traffic control began to bring it more and more into the realm of engineering.

Often where the traffic control officer is a policeman, the "behind doors selection" of the apparatus is made by the city engineer whom the policeman naturally consults where technical knowledge is involved. This, we may add, parallels the practice of waterworks superintendents who frequently consult the city engineers. A fire chief uses the water but knows little or nothing about the design, construction and operation of the system that supplies the water. Similarly a police chief may use a signaling system, but without little knowledge of its design or technical merits.

City engineers would do well to emphasize this fact wherever it is not already recognized. They should urge the employment of engineers as guides in selecting and locating street signals. In a word, they should do all that is possible to hasten the day when traffic control will be as completely under scientific direction as railway signalling has long been.

In the case of county and state highways, engineers are already the traffic control officials, for the most part. And they should resist any attempt to take this function from them. It is clearly an engineering function, and it is one that is growing rapidly in importance.

H. P. Gillette

Why Road Builders Should Attend the Road Show in January

The annual meeting of the American Road Builders' Association and the "Road Show" will occur in Chicago during the week of Jan. 10 to 15.

Coming at a time of year when most road builders can spare a few days to exchange ideas and to study the latest designs of equipment, this meeting and show have always attracted a large attendance.

There is no branch of construction that is growing at so rapid a rate as highway construction. But in spite of its remarkable

growth during the past decade, and in spite of the antiquity of its origin, road building is in its infancy, both as to the volume of annual construction and as to the design of the finished roadways and the machinery with which they are built.

Thousands of able engineers, contractors and manufacturers devote at least a little of their time annually to devising improvements. In the aggregate, this ingenuity becomes impressive, especially, when it is possible to review it as an aggregate. Such an annual review of progress the Chicago Road Show and convention are designed to furnish.

The inspiration that this annual review creates should alone be worth the time spent and the cost of coming to Chicago once a year. In addition, there is always the probability that a direct and immediate profit will flow from examining some new device or design.

We hope to register an even larger attendance of road builders at the convention and road show next January than was registered the year before.

Constructing Integral Curbs Without Face Forms

To the Editor: On page 223 of the October issue of Roads and Streets, there is an article on "Building Curbs Without Face Forms," which article states that the method of constructing integral curb, without face forms, was developed by contractors in the Chicago district, to which the writer wishes to take exception.

This method was adopted by the writer at Rockford, Ill., in 1922 and has been used continuously since that time. Rockford contractors brought this method of building integral curbs into the Chicago district.

This type of curb was designed by the writer for the purpose of obtaining cleaner gutters on city streets, and also reducing upkeep and maintenance of motor driven sweepers, as the vertical type of curb was detrimental to motor driven sweepers.

B. C. HARVEY,
Public Engineer.

Rockford, Ill.

Macadam Bases for Brick Pavements

To the Editor: There is no question in my mind that you are perfectly correct in the statement made in your excellent editorial in the October, 1926, issue of Roads and Streets with regard to the use of macadam bases for brick pavements.

I have personally inspected a number of brick pavements built on new broken stone bases and they have remained in an excellent state of preservation after many years of heavy traffic. In the article by Messrs. Teller and Pauls on the Arlington Tests of Thin Brick Pavements there is a statement on page 142 of the September, 1926, issue of Public Roads as follows: "A wide range in the type and construction of base used was noted in the survey. Concrete ranging from 4 to 6 in. in thickness and largely of 1:3:5 proportion was found to have been used extensively in the area covered, while old and new macadam had been used satisfactorily in many instances." . . . "The successful use of these widely different types of base indicates that there is a wide range of possibilities in base construction. Any material which remains stable at all times would appear to make a satisfactory base for a brick pavement. It is evident that these requirements may be met in many cases by base construction of the less rigid type. As the function of the base is primarily to support the allowed wheel loads without appreciable vertical displacement, any type of construction that will meet this condition is satisfactory. An old macadam or other type of surface that has proved stable under traffic should prove entirely satisfactory as a base for brick."

The observations by Messrs. Teller and Pauls agree entirely with mine, provided a bituminous filler is used for the brick. A non-rigid base necessarily will show more vertical movement under loads than a rigid base and it is therefore unwise to use a Portland cement group filler, for the surfacing should be permitted to accommodate itself to the vertical movements in the base.

A. T. GOLDBECK,
Director Bureau of Engineering, National Crushed Stone Association.
Washington, D. C.

To the Editor: Your editorial in the October issue of Roads and Streets is splendid and it is very interesting now to see the suggestions you made years ago develop into general practice.

So far as waterbound macadam and other types of stone, slag or gravel bases are concerned, we have always recommended their use and have every reason to believe that they are feasible, practicable and economical. Many communities, as you know, have pavements of this type, one of the most outstanding examples of which is the National Pike through Ohio, which has seen years of service and very intensive traffic. In city street paving there is some objection to this type of construction on account of the replacements of service cuts, but in highway construction the rolled stone type of bases are proving very satisfactory.

As to the cost, we have found in many instances that a macadam base construction costs as much if not more than concrete, and where the cost is the same or less, concrete has generally had the preference.

EDWARD E. DUFF, JR.,
Secretary National Paving Brick Manufacturers Association.
Cleveland, O.

Standard Questionnaires for Bidders

Editorial in October Highway Builder

Use of Standard Questionnaires for bidders as adopted by the Joint National Conference on Construction Practices shows gratifying progress. The recent action of the Pennsylvania Department of Highways is requiring their use by all low bidders, following that of Illinois some time ago, insures their use in the two largest road-building states as well as other states which have given them currency. A third surety company has recently added its name to the two others which have previously adopted and expressed their intention of using these documents. The American Bankers' Association, after more than a year's study, has approved them and will recommend their use to bankers throughout the United States.

The sum total of the above endorsements, added to those of various national societies concerned with construction, represents an impressive recommendation of the constructive nature of these questionnaires. Constructors can do much to bring about more general use of the documents by co-operating wholeheartedly when requested by underwriters to use same. They have been, perhaps, the loudest shouters against irresponsibles within their ranks. It is, therefore, their manifest duty to accord one hundred per cent co-operation in this constructive movement for the betterment of their business, notwithstanding the fact that such co-operation may cause temporary expense and inconvenience.

Gasoline Consumption Increases.—Gasoline consumption in 32 states, as indicated by reports of distributors in various states under provisions of gasoline tax or inspection laws, for seven months ended with July, 1926, totaled 2,370,817,000 gal., against 2,039,881,000 in the same period of 1925, an increase of 16.2 per cent, according to the American Petroleum Institute. Gasoline consumption in the same thirty-two states in July totaled 424,705,000 gal., against 376,058,000 gal. in July, 1925, an increase of 12.9 per cent.

Mexican Road Official to Preside at Road Congress

For the first time in 24 years an official of a foreign government will act as co-chairman of the annual road congress which will be held by the American Road Builders' Association, Jan. 10th to 14th, in Chicago. Mr. F. Diaz Leal, member of the Federal Highway Commission of Mexico has been invited to preside on Pan-American Day, Jan. 12th, as a representative of his country. His co-chairman will be Col. R. Keith Compton, Director of Public Works of Richmond, Va.

Mr. Diaz Leal is a member of the Federal Highway Commission of Mexico and previously served as Director of National Works and of the Bureau of Communications and Public Works. He is also a Professor of Engineering of the National University of Mexico. Mr. Leal is highly regarded among highway officials both in this country and in Mexico. His presence on the platform on Pan-American Day will undoubtedly do much to make the Pan-American meeting a success.

Mr. Leal will arrive in the United States immediately after the first week of January and will go into conference with Col. Compton, his co-chairman.

Qualifications of a Chief Engineer

The citizens of Baltimore, Md., voted at the November election on an amendment to the charter of the city which provides for the creation of a department of public works. It is provided in the amendment that the head of the department shall be the chief engineer of the city, and that he shall be appointed by the mayor. The amendment further provides that the chief engineer shall have the following qualifications:

"The chief engineer shall have general educational equipment at least equal to that of graduates of high schools. The mayor, when appointing a chief engineer, shall give first consideration to the qualifications of those who are graduates in engineering from a recognized college or technical school of collegiate grade. The chief engineer shall be a person of broad experience and high standing in his profession, and shall have had responsible charge of engineering works over a period of at least ten years. If the person appointed as chief engineer is not a graduate in engineering from a recognized college or technical school of collegiate grade, he shall, have had not less than fifteen years' experience in engineering, during ten years of which he shall have been in responsible charge of important engineering projects. . . ."

Wider Highway for Heavy Traffic

Notable Example in California, Oregon, and Washington Given in October Concrete Highway Magazine

On the Pacific Coast, in California, Oregon and Washington, are to be found some notable examples of the cognizance taken of the necessity of greater paved road area on the main traveled highways, arterial streets, bridge approaches and business streets.

In California, one of the outstanding highway projects of recent years was completed this summer in the replacement of a 24-ft. macadam roadway with a concrete-paved "superhighway"—72 ft. wide—over the summit of Cahuenga Pass, north of Hollywood. This heavily traveled highway, forming Los Angeles' main outlet to the north, was paved with concrete which averaged 10½ in. in thickness. Contracts have been awarded since for its extension.

Some Washington Developments.—Second, perhaps, in importance to a large population are the provisions made by the State Highway Department of Washington for wide highways between Tacoma, Seattle, Everett and Marysville. These projects will form sections of the Pacific Highway.

Some years ago, due to the heavy volume of traffic between Tacoma and the army cantonment at Camp Lewis, the state laid a pavement parallel to the existing one and confined travel in each direction to its individual strip. This plan proved so acceptable that later provisions for heavily traveled highways have been made to include this type of 2-strip highway.

Between Seattle and Tacoma, an already crowded valley highway and subsequent crowding of an optional route has resulted in plans for a major "crow-line" route which will be paved with two 20-ft. strips of concrete, separated with 4 ft. of gravel. Grading of this 50 to 58-ft. roadbed is practically completed and pacing is scheduled for 1927. Bridge and viaduct construction, approaching $800,000 in cost, built in connection with this new highway at the Tacoma end, is being pushed to completion at the present time. This provides a 36-ft. roadway with a 5-ft. sidewalk on each side.

Similar construction is under way between Seattle and Everett. From the Seattle city limits, the North Trunk Highway—at present 20 to 22 ft. wide—will be widened to make 44 ft. of continuous roadway to the King-Snohomish County line. Extending from this county line to Everett, the pavement will consist of two 20-ft. concrete strips. Beyond Everett, construction work is under way on a 4-unit bridge, viaduct and road project, approximating $1,000,000 in cost to shorten the distance to Marysville. This project has a roadway of 24 ft. The whole superhighway project from Tacoma to Marysville is 66 miles long, replacing existing routes of 84 and 75 miles in length.

California Highway Projects.—Returning to California, other important highway projects typical of the trend toward relieving traffic congestion by increasing width, include the following:

Pico Boulevard, Los Angeles, a main artery to Santa Monica and the ocean, is, at present, being paved with 8-in. concrete (10-in. edges) to a width of 70 feet.

A section of California state highway between Montebello and Whittier (Los Angeles County), was completed in December of last year to include 3.3 miles of 56-ft. concrete pavement—9-7-9 thickened edge type. For this wider pavement, the state secured additional right-of-way to make an 80-ft. roadway.

Washington Boulevard, Los Angeles County highway was paved with concrete between Culver City and Venice—2.45 miles—to a width of 78 ft. between curbs. It is proposed to make this highway which carries the principal beach travel 100 ft. with 70 to 78-ft. pavement. Construction on the Culver City-Venice section was completed May, 1925.

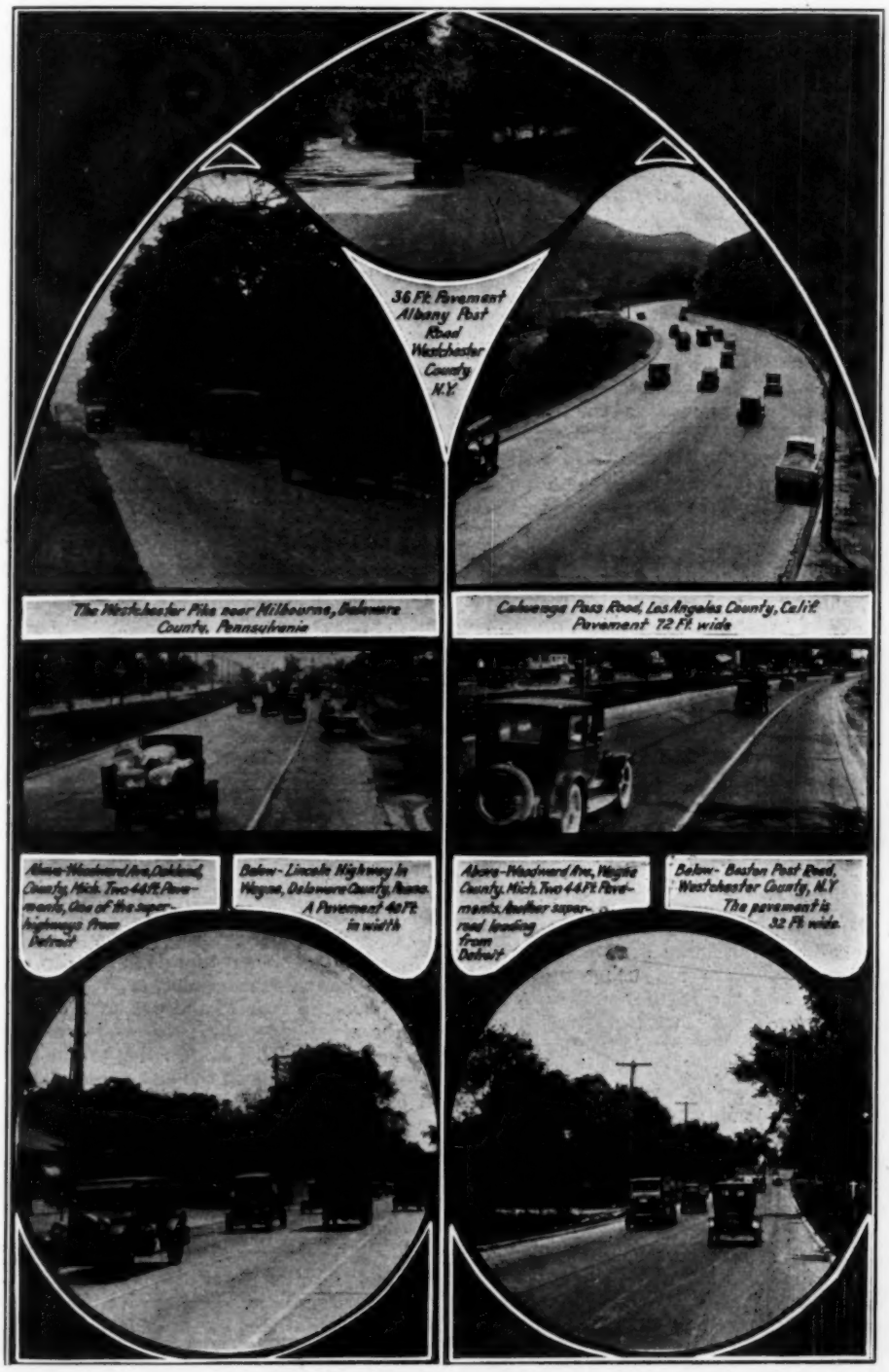
Anaheim Street, Long Beach, built in 1925, is 65, 70 and 100 ft. wide between curbs. Condemnation proceedings are reported to be under way to make this uniformly 100 ft. of paved width.

The comprehensive cooperation of the Los Angeles County Regional Planning Commission and the Los Angeles Traffic Commission with the officials of the cities involved, and the efforts of these organizations to provide relief for a growing traffic are having far-reaching results.

Man highway widening is general in the regions of Los Angeles, Santa Barbara, San Francisco and Oakland with additional strips at the sides of existing highways—in some cases involving resurfacing between the concrete shoulders or resurfacing with a second story of concrete.

This general widening is found at many points along the Pacific Highway from Mexico to British Columbia under the far-sighted planning of the California, Oregon and Washington State Highway officials.

Widening Projects in Oregon.—On May 21, this year, the voters in the city of Portland, Oregon, passed a bond issue for $1,500,000, to be used for widening bridge approach streets. On the same day, Multnomah County (Port-



Seven Interesting Examples of Recent Highway Widening Developments

land), approved a $2,500,000 bond issue to be used for widening main arterial highways.

Portland's bridges across the Willamette River connect its east side residential section with the west side, which comprises the business section as well as a residential section. Plans are formed, and some work is already under way, to provide wider streets leading to the Broadway, Burnside and Ross Island bridges. These plans provide for streets up to 110 ft. in width and many of the projects extend, at less width, of course, a mile or two from the river.

Among Multnomah County's widening plans, the largest item included in the County Commissioner's program is for reconstructing with increased width the Canyon road from the city to the county line over the southwestern hills. St. Helen's road, approximately 4 miles in length, will be widened to 36 ft. One mile of the Capital Highway from 18 ft. to 27 ft. and sections of Pacific Highway are included.

The need for wider highways is becoming well established on the Pacific Coast as these projects will testify. Increasing vehicle registration, wider use of motor trucks and the greater efficiency and safety afforded by wider paved highways are found to be the prime factors in the universal movement for wider highways on the Pacific Coast.

Grader Hitch

A way of utilizing a horse drawn grader with the regular maintainer has been worked out by J. E. Morriss, a representative of the Full-Crawler Co. By this plan a trail grader can be used with a one-man power grader or two trail graders can be used.

After working with many county commissioners, townships, cities and state highway departments, Mr. Morriss found that nearly all of these had several horse drawn graders on hand which they were not using but which could be used with the regular maintainer for maintenance work. A Trackson-Fordson can handle both easily.

The plan of Mr. Morriss' whereby it is not necessary to buy an offset or engine hitch to attach the second grader to the first, is now working very successfully in Marion County, Tex. Here the state let a contract for maintenance work to the county commissioner. This commissioner had two graders on hand which were designed for horses. These graders had 7 ft. 6 in. blades. The second grader, which was run behind the first one, was set so that it would move the dirt left by the first grader. To attach the first grader to the tractor, Mr. Morriss recommended using a 5 ft. 6 in. stub pole, as it would afford better turning. To have a center line of draft, an offset hitch was necessary for the hind grader. This hitch was made as follows:

The regular horse-drawn pole was cut off, making a 3 ft. 6 in. stub pole. Above the stub pole, fastened to the same king pin, was a 10 ft. pole. At the lower end of the stub pole a clevis was placed and from this clevis was a 1 in. rod, 42 in. long, with a clevis on the other end that clamps to the upper pole. This made it possible to give the rear grader the offset wanted and at the same time, gave a center line of draft and a sufficient angle

By Using the Hitch Described Above the Adams Grader Spreads the Dirt Removed from the Ditch with Wehr Grader Equipped with Trackson Full-Crawler

so that the dirt moved by the first grader was spread by the second one.

Mr. Morriss has worked out the same kind of an arrangement with a one-man power grader. The best results were obtained by using two ¾x3x48 in. iron bars that attach to the drawbar of the Fordson. Use one bar, the same size and length from the rear of the grader to the double bar, drilling four holes in this bar so that any desired angle may be given. This bar, attached to the double bar, 20 in. from the rear end, using a grader that is equipped with an engine hitch, will allow the operator either to move the dirt thrown out by the one-man grader, or, by changing the bar from the rear of the grader from the left to the right side, the rear grades can be put in the ditch. This allows the one-man grader operator to cut down the side walls. This gives a clean place on the road of street for the dirt moved from the ditch.

The cost of the hitch for the one-man grader is between $8 to $10. The cost for the hitch for the two horse-drawn graders is between $4 and $6.

Good Results from Strict Enforcement of Traffic Regulations.—Strict enforcement of traffic regulations in Columbus, O., is bringing good results. A "Pay-as-you-violate" Bureau has been established; even pedestrians are arrested if they disobey signals.

Snow Removal in Western States

Methods in Utah and Wyoming Described in September Proceedings of American Society of Civil Engineers

Snow Removal in Mountain Regions

By B. J. FINCH
District Engineer, United States Bureau of Public Roads, Ogden, Utah

The problems of organization and operation in snow removal are of a general nature and apply as well to the sparsely settled regions of the West as to the densely populated sections of the East. Snow removal is so closely related to maintenance that it is difficult to separate the two.

An organization for snow removal necessarily has its nucleus in the regular maintenance forces. Because of the variation in the time at which and for which the extra personnel is needed, there must be a great measure of elasticity in the make up of the forces. This means that the regular force of the maintenance department must be well trained, loyal, and capable of functioning within itself as well as when greatly expanded.

One of the features of snow removal work which applies more peculiarly to the mountainous regions is that of opening up mountain passes in the spring after the snow has disappeared below and only the passes prevent communication between the valleys. This applies to transcontinental roads as well as to local roads, as wherever the passes in the intermountain region are above 8,000 ft. elevation, all communication except by sleds becomes dangerous and almost impossible for a period of from three to five months.

When the time comes for opening these passes, there are two distinct problems to be solved. The first is, of course, to get the road opened in the most economical manner and in the shortest time. The other is to protect the grade and structures from erosion while the snow is melting; this can be done only by the prevention of washing by patrolmen who direct the flow of water to the regular channels as closely behind the melting snow as possible.

Many different devices are being proposed for this type of snow removal from the heavy rotary plow to the simpler forms of grader. The amount which can be spent for opening a road depends on its use. If a road is of sufficient importance so that its opening a month in advance of the regular season is worth considerable to the traveling public, a proportionally great expense is justified. Where the traffic is small, however, say, below 50 cars per day, cheaper methods of removal are necessary even if the time of opening is delayed somewhat.

Dusting or Sanding Snow.—One method which is being tried with success in many sections where a fair proportion of sunshiny days prevails is that of "dusting" or "sanding" the snow. This operation may be briefly described as sprinkling on the surface of the snow a dark colored, light weight, granular material which, when exposed to the sun's rays, attracts and holds enough of the heat to cause the snow around the particles to melt. This breaks up the even surface of the crust and greatly hastens the disappearance of the drifts. This method is being tried with good success in some parts of Idaho. The work of "sanding" or "dusting" can be done by the same patrolmen who are looking after the flow of water in the ditches. This method often reduces the time for opening a pass to half that otherwise possible without a heavy expenditure. It also makes unnecessary the shoveling which otherwise would be necessary to eliminate many drifts that may be cut away by the action of the sun. A crew of two or three men can do the work of a much larger outfit, and the organization correspondingly reduced.

Another factor that enters largely into the question of snow removal is the location and design of the roads. In the densely settled sections of the East the location of a road is more or less fixed by improved real estate. In the West, however, there is opportunity, particularly in the roads over the mountain passes, to locate the new highway in the place where interference from snow will be a minimum. In some cases snow studies have extended over a period of several winters, with the result that when the road has been built it lies where drifting is least likely and where the exposure is such that most of the snow removal is done by the wind and sun.

The day when main highways can remain closed for months is past. The public is demanding, as it has a right to do, traffic facilities for continuous use of the millions of motor cars which it has purchased. Engineers must face this situation squarely and organize their maintenance departments so that the roads will be in acceptable condition not only for the season of heavy travel, but also for the lighter, but possibly more necessary, traffic during the winter months.

The Snow Problem in Wyoming

By Z. E. SEVISON
State Highway Engineer of Wyoming

The writer desires to present those principles adopted at the very beginning of the construction of the highway system of Wyoming, which have governed the location, design and construction of all such highways built in that state. It is believed that these principles are worthy of careful consideration in all localities where snow conditions prevail, in order that this hazard may be reduced to a minimum.

The Matter of Location.—The proper location is of primary importance and should be governed by the topography, the prevailing direction of the wind during the winter, and the exposure, with grade and curvature, within allowable limits, receiving secondary consideration. The sacrifice of alignment and grade to a reasonable extent may be necessary to secure a snow-free road. In a country subject to snowfall, the successful locating engineer must not only be familiar with the territory in which he is working, but should have a good knowledge of the winter weather conditions which generally prevail.

In the open areas of the Western states the location should be made on ridges or on slopes against the prevailing direction of the winter wind, so that an elevated roadbed will be swept clear. All cuts are to be avoided, but where this is impossible the location and construction should be such that they will be swept clear by the wind. In the mountainous areas where the traffic is not sufficient to justify keeping a road open during the winter months, proper exposure is fundamental, and in conformity therewith the best possible grade and alignment that the country affords should be secured.

The winter season may be utilized to advantage in determining the location except in forests or mountains, or a preliminary study may be made with sufficient notes as to snow conditions so that the locating engineer may be governed by these when the survey is made. If neither of these plans is followed the final inspection of the line should be made in the winter and prior to the completion of the plans. The notes of the location survey must be complete as to snow conditions so that the designer will have all the necessary data.

Highway Designs from Standpoint of Snow Hazard.—The design of the highway from the standpoint of snow hazard must be in the hands of an experienced engineer. In general, the surface of the roadway should be from 1 ft. to 3 ft. above the ground line at center line. This is governed by the lateral slope, vegetation, and the drainage requirements. Where cuts are unavoidable they should be "daylighted" or widened to the right-of-way line and all material used in fills or wasted below the grade line. The elevated grade line has the advantage of simplifying snow removal, should that be necessary, and this practice should commend itself to the Eastern highway engineer; it also provides better drainage. In addition, some cuts will require snow fences. A right-of-way width of not less than 100 ft. is recommended in order to reduce the possibility of drifts caused by weeds along the right-of-way fences, and to furnish ample borrow.

Through forests and mountainous country where it is improbable that traffic requirements will demand a year-around road, or where topographical conditions govern, the usual design of balanced quantities should be modified to the extent of elevating the grade line sufficiently so that every advantage of correct exposure will be utilized and a dry roadbed obtained at the earliest possible date each season. This is important for the reason that few mountain or forest projects have been surfaced, principally due to lack of funds. The construction requirements are practically the same as for the usual location and design. All vegetation, brush, sage brush, and trees should be removed from the right-of-way and borrow-pits should be located so as to take advantage of slopes and wind.

It is realized that highway location and design as herein described may not appear adaptable in the older sections of the United States where the territory is closely built up and it may be necessary to follow established roads and grades, and where rights-of-way are narrow, yet the speaker is convinced that these principles may be closely approached. The major difference between the East and West is characterized by a heavy snowfall in the East without much wind, while in the West (Wyoming particularly) the snowfall in any one storm is usually light, accompanied by winds which cause drifting. These drifts become hard-packed within the period of duration of the storm and are difficult to remove with ordinary equipment. Even weeds or grass along the shoulder, or a right-of-way fence close to the roadway will cause drifts, hence the importance of proper maintenance to insure clean shoulders in the fall of the year, and wide rights-of-way.

When the traffic has reached a volume on an old road such that reconstruction becomes necessary or a parallel route built, the cost of snow removal on the old route should be compared with that on a route properly located and designed. It seems probable that this item of the final cost of a road has not been given the consideration it should have had in arriving at the economic location.

Snow Removal Organization and Operation in Utah

By HOWARD C. MEANS
Chief Engineer, Utah State Road Commission

The removal of snow from road surfaces is one of Utah's newer maintenance problems. In the days of horse-drawn vehicles no one ever thought of snow removal except for pedestrians. In the early days of automobiles the owner generally housed his car during the winter or at least confined it to town use. With the present tremendous investment in motor cars, together with the absolute necessity of using them in all walks of life, however, the economic demand is such that main trunk-line highways must be kept open for constant use, winter and summer. This demand justifies the expenditure of almost any amount of money within reason.

Another reason for the constant use of the highways during the winter is the extensive use of non-freezing solutions in automobile radiators and the increased number of closed cars. This makes travel by automobile both possible and comfortable. Within a few years snow removal will be regarded as an essential maintenance operation, as railroads look on it today. Even now the car owner who happens to be held up for a short time on a road that is being kept open has cultivated the habit of complaining about the delay instead of being happy that he can get through at all. The problem of clearing road surfaces of snow in the most economical manner is confronting the highway maintenance organization of all states where snowfall occurs.

Why Highways Should Be Cleared of Snow.—In addition to these economic features of winter travel, there are three reasons why highways should be cleared:

First.—If snow remains on the road surface a layer of ice forms, and the action of tire chains soon cuts through this ice to the pavement. Cars are compelled to follow this one lane of travel, as it is next to impossible to leave it when the occasion requires. This condition caused many accidents in Utah during the winter of 1924-25 in sections where it was impossible to commence clearing the snow immediately after it fell. On one inspection trip between Salt Lake City and Nephi, a distance of 90 miles, five cars were reported with bottoms up.

Second.—The result of confining traffic to these single lanes shows a tremendous wear on the paved surface. In the case of one bituminous pavement, laid during the previous fall, it was found after the surface had been cleared that the action of the tire chains had torn loose considerable of the wearing surface and had formed ruts throughout its entire length.

Third.—Spring maintenance is naturally increased when snow is left on the road surface during the winter. Melting snow, confined as it is, soon soaks the sub-grade and produces disastrous results.

Organization and Equipment Essential.—Of course, organization and equipment are essential in all lines of endeavor connected with highway construction and maintenance, but they are more essential in snow removal than perhaps in any other kind of work, on account of the conditions under which an organization labors and the kind of tools with which it has to work. As an illustration, during the winter of 1924-25, in the removal of snow on one section of road in the northern part of Utah it was necessary to keep in constant use the available equipment on account of a stiff wind that filled the roadway with snow about as fast as it could be cleared. The low temperature, about 37 deg. F. below zero, necessitated the use of a distillate in the radiator, as no anti-freezing solution could be used successfully.

By "organization" is meant a crew of men that can be depended upon to perform their work regardless of time or conditions. The very nature of the work requires loyalty, untiring efforts, and courage to grapple with work that has the appearance of approaching the impossible. These crews are called upon to work long hours, night and day, because it has been demonstrated that the time to commence the work is when the snow begins to fall. In the mountain states the high passes required to be kept open are naturally the most difficult sections. In Utah, the winter of 1924-25 was the first in which an organized effort was made to remove the snow from the main highways.

It was found possible to keep open the road from the Idaho line on the north through the entire length of the state to the Arizona line on the south. No attempt was made to clear the east and west highways. The Uintah Basin in the northeastern part of Utah is without rail transportation, consequently it is necessary to keep open this connecting link over a summit 9,200 ft. high. This was accomplished by working three 10-ton caterpillar tractors each equipped with a snow plow, the work being carried on in co-operation with the United States Postal Service.

Snow Removal Equipment.—The kind of equipment to be used in snow removal is a question that will bear a great deal of observation and study. Throughout the highways where only a light snowfall occurs the problem is comparatively easy, the snow being pushed off by plows attached to trucks and

tractors. By constant attention the highways can be kept clear with a reasonable amount of effort. In high country, however, the problem is not so easy. Where snow falls each winter to a depth of perhaps 5 to 8 ft., and the wind blows almost constantly, it is a difficult problem. Through one pass in the northern end of Utah, this was accomplished by the use of caterpillar tractors and snow plows with blades built up to the height of 5½ ft. However, with this kind of equipment it was found that the snow quickly piled up along the sides. It was a tremendous task to shove it off the grade or dispose of it in some way so that new snow could be handled. With rotary plows the snow might be removed entirely with one handling.

Another usable piece of equipment for removing snow up to a depth of 12 in., is the Hadfield-Penfield or Weir one-man grader, using a Fordson tractor as the mobile unit. The advantage of this equipment is that it can move quickly and cover considerable distance, but of course, it is naturally confined to light work.

Removal of Guard Rails.—The usual guard rail necessary during the summer on high mountain roads becomes a serious menace during the winter and considerable thought has been expended in just how to devise the removal of guard rails. Possibly, this can be accomplished by sawing off the wooden posts close to the ground and using a 2-in. pipe as a dowel connection between the stationary and movable parts. Snow fences perform an important part in some sections of highways in this mountainous country. Usually the prevailing winds are from one direction and the problem of placing snow fences in such a position as to hold the snow successfully is a question requiring individual study. The necessity of considering the snowfall and the direction of wind in the original location of highways is an important problem of the locating engineer. Excessive construction costs are not justified in attempting to arrive at an ideal condition, but often locations where the direction of the prevailing winds will clear the snow from the road surface without additional cost may be chosen. In other cases the location is made after exhaustive study, with the definite knowledge that snow removal is to be a requirement.

Costs in Utah.—During the winter of 1924-25, snow removal was carried on in Utah along several hundred miles of road. Much of this presented no particular difficulty as it was in a country of light snow. However, 134 miles did present a real problem. The cost of this work averaged $81 per mile, ranging from $456 per mile on one section of mountainous road to as low as $15 per mile on another section adjoining it.

Where snow removal is necessary the cost should be a part of the annual maintenance budget and should be approached with as definite an idea of accomplishment as every other part of maintenance.

Earth Road Reconstruction

Blade Grader Work in Nova Scotia Described in Paper Before Canadian Good Roads Association

By R. W. McCOLOUGH
Chief Engineer, Department of Highways of Nova Scotia

With the completion of the main trunk system, there came a demand for wider and better secondary roads. The narrow road, which by comparison with the best roads of the province formerly was considered good enough, was not considered satisfactory. On account of the large mileage and the scarcity of funds, the department had to discover a cheaper means of reconstructing the secondary earth roads.

With this end in view, the Department of Highways in the spring of 1926 purchased five 10-ton or 60 hp. caterpillar tractors and five 12-ft. blade graders with scarifier and back sloper attachments and weighing approximately four tons. These outfits have been used on our secondary roads during the present season with marked success.

We had only two objections to the heavy outfits: (1) They were too heavy for the floor systems of most of our bridges. (2) The owners of horses kicked on account of curtailed employment.

The first objection was overcome by using four sticks of 12 by 12-in. by 20-ft. timber to carry the tractor over weak bridges (so far we have not had an accident); the second, by better hauling conditions on the improved roads.

The character of the work done soon convinced the owners of horses that the horse grader could not compete with the big outfits and as a consequence the objection from this source was soon withdrawn.

Advantages of Tractor Outfits.—An outfit of this kind has many advantages:

(1) While heavy clearing has to be done in the usual way, small trees and bushes are graded out by the blade.

(2) No plowing or grubbing is necessary.

(3) Stones up to one-half ton are handled easily by the blade.

(4) The ditches are back-sloped and completed by the back-sloper.

(5) The character of the work is very much superior to that done by the horse grader.

(6) The work can be done at about one-fifth the cost of horse grader work.

(7) Trees can be uprooted by tractor.

Organization of Tractor Outfits.—It is of course essential to lay out carefully the season's program for each tractor in order that unnecessary moving or travelling may be avoided, and work conducted expeditiously and economically. Each outfit requires a trailer to carry a complete set of small tools, timber, etc. This trailer may either be hauled by the tractor or horses may be employed for the purpose when necessary.

As personnel, we carry one tractor operator, one expert grader operator and one superintendent, the latter being furnished with a light Ford truck.

Costs.—The average total daily cost of the outfit including all charges for rental, supplies and labor is $125 per day. We charge a rental of $30 per day for the tractor and $2 per day for the grader.

The cost per mile varies from $135 to $350 per mile, according to the work. Similar work done with horse graders costs $800 to $2,000 per mile.

We have kept an accurate record of the performance of these outfits. One outfit regraded seventeen miles of roads in 29 days, moving 40,000 cu. yd. of material at a cost of 6 ct. per cubic yard. Another, five miles in seven days, moving 15,000 cu. yd. of material at a cost of 6 ct. per cubic yard. Both roads were widened from a width of approximately 10 ft. to a minimum of 20 ft.

Bleeding Tar Macadam Treated with Asphaltic Oil

During the summer of 1921, Section "C" of Federal Aid Project No. 48, Jefferson County, Kansas, was paved with a 2-in. tar macadam top on a 6-in. rolled stone base. Section "C," now designated Red Star Route No. 16, is a winding road through the hills of Jefferson County.

Toward the end of the construction of the road and early in 1922, the tar wearing surface was found to bleed very badly. As a consequence, the Federal Government directed that the road be given another treatment for the purpose of putting a stop to the bleeding.

Due to the necessity of letting the work twice, and also as a result of an embargo preventing the shipment of chats and Joplin

View of Road 3½ Years After Treatment. Material Along Roadside Ready for Retreatment

flint, to be used in the retreatment, the work could not be carried out until early in 1923. In the meantime, the tar had continued to bleed and it seemed that the proposed application of 3/10 gal. of Texaco special macadam binder would be insufficient for the road in its condition at that time. It was finally decided, however, to carry out the original plan and use 3/10 gal.

In September of the present year, 3½ years after the retreatment of the tar macadam with asphaltic oil, the condition of the road surface was hard and smooth. The bleeding and flowing of the tar had been stopped almost completely.

Last September, an additional application of the asphaltic oil employed in 1923 was made. The quantity of material used this time was .35 gal. to the square yard.

Roads Across Swamps

Notes on English Practice in The Surveyor, London

By REGINALD RYVES

Theory as to the methods to be followed in making a road across a swamp or bog depends almost entirely upon the successes of engineers in specific cases. It cannot be admitted, however, that there are no well-established principles relating to water and earthy matter and having a bearing upon the subject.

General Principles.—Two of these, which seem to have received very little attention, may be explained as follows. Advantage may be taken of the dry season of the year to "reclaim" the strip of land on which the road is to be made. Any pool of water that stands at a level slightly higher than that of the lowest water surfaces near it may be drained by means of cuts made through bog-moss or other masses of vegetation. Mud, not earth, may be brought to the site and laid upon the strip until the level is a little above that of the swamp in the middle of the strip and just level with it at the outer edges where it disappears as a slope. The whole width of this strip should be about twice that of the intended embankment. The surface should slope evenly from the center line to the edges. As this mud dries and sinks, more mud is added and smoothed down. It must be mud and not earth, the actual water content of mud which has been left to drain for a short time being less than the volume of the voids in the same bulk of dry earth. In this way some bogs, and many places where the ground is treacherous, may be prepared for the embankment proper, mud only being used until it is certain that the material is permanently above water level. Even the clayey mud is the best material.

Roadmaking in Flanders.—As an example of the behavior of mud, suitably applied, the following case of primitive roadmaking under war conditions in Flanders may be illuminating. It was realized that if a road was deep in mud and water so that after the passage of a cart or lorry deep ruts, full of water, were left behind it, advantage could be taken of a spell of dry weather to create a firm roadbed on which a little stone would suffice to form a resistant crust. The previous method of dealing with such cases had been to tip stone or brickbats, usually into the ruts only. The capacity of the Flanders subsoil to receive and engulf such contributions seemed to be unlimited, and no improvement was effected. When, however, at the beginning of a spell of dry weather, the ruts were filled with mud, the most clayey that could be found, and the whole road surface, which was already mud, smoothed with the backs of shovels, the water at once began to run off the road. After each passage of a vehicle the ruts were refilled with mud and the surface again smoothed. The road dried out, the ruts being filled with mud as often as they were formed, until it was possible, by applying a little stone over the whole width, to form a resisting crust which prevented the formation of ruts. Such a road could then, if necessary, be rapidly provided with a sound and lasting crust, no more in quantity than that needed on a firm and dry soil. It may be noted that the first thin layer of stone should be beaten into the mud and the remainder mixed with a due proportion of binder. If the bulk of the stone be applied without binding material to fill the voids it will hold enough water, after heavy rain, to soften the mud, which then engulfs the whole of the stone. This principle of mud filling is applicable to many small works of what would otherwise be "drainage"; also to embanking. The main fact on which it depends is that mud settles into a compact mass of solid material, the water coming to the top.

The other principle that has been neglected in the case of roads made over swampy ground is that of thrusting water away as distinct from and often preferable to draining it away. It is, in fact, as important as any principle in relation to works of land drainage. As applied to a road embankment across a swamp, it consists in first creating, as a base for the embankment proper, a strip of ground very little above water level and having, therefore, no considerable weight to force it outwards into the bog. At its edges, very flat slopes down into the bog must be formed, not by additions upwards from the bottom of the bog, but by additions sideways from a middle strip, the making of which may demand measures not included in the scope of this article; the principle to which attention is specially drawn being that of extending a solid mass of earth or drying mud by additions at the edges, which push the water further and further away as the work proceeds.

Compulsory Road-Work in Nicaragua.—In the Gaceta Oficial of Nicaragua for April 30, 1926, a new road-conscription law was published which requires all male inhabitants of the Republic, native or foreign, over 18 years of age, to contribute to the construction and maintenance of highways. Departmental highway boards will register all male residents and exact the highway-service tax in either so many days of labor or in cash payment, graduatel according to the earning capacity of the individual.

City Manager Government

Report on Its Operations, Based on 6 Months' Tour of Manager Cities. Given in Address Presented at Recent Convention of City Managers Association

By PROF. LEONARD D. WHITE
Department of Political Science, University of Chicago

No one who is familiar with the history of American municipal government can deny the notable achievements of the city manager movement. The success of the manager governed cities is both a result of a general underlying trend toward improvement of our municipal institutions, and a contribution to the further improvement in city government which lies ahead. Other types of cities, too, show improvement in the last decade, and managers themselves would be the first to insist that the great transformation of city government in the last generation is due to many co-operating causes. In passing we may note the contribution of the Annual Conference for Better City Government, the National Municipal League, the Society for Municipal Improvements, the National Civil Service Reform League, the advocates of sound budget methods, and the Short Ballot Organization.

City Managers Have Established Integrity of Purpose.—But the managers have made important contributions to their own cities and to good city government everywhere, and it is in these that we are chiefly interested. Without attempting to do more than indicate the leading items, I list first of all the fact that the managers have almost universally established their integrity of purpose so clearly that it is admitted by the opponents as well as proclaimed by the friends of the manager. In no town that I visited did I fail to find skeptics or critics or enemies of the manager. Managers are jointly and severally charged with being autocrats, kaisers, czars and enemies of democracy; they are sometimes called the tool of the local capitalists; they are often called spendthrifts and visionaries; sometimes they are alleged to talk too much; but never are they seriously charged with lack of personal or official integrity. I want to pause to emphasize the importance of this, for during a long period of municipal government, the integrity of the chief executive was frequently open to suspicion, and often with justice.

The result was necessarily that public confidence in city government declined and in some cases almost disappeared. In a democratic government this is the worst sin that can be committed by the men in charge of public affairs, an assault upon the very foundation of popular government itself. Managers have the high merit of co-operating with right-minded officials in other cities in restoring the confidence of the people in the honesty of their government. By this work alone they are justified.

City Managers Advancing Cause of Good Government.—But in restoring the confidence of the people in their city government they also became the agents for the rescue of city administration from city politics. For fifty years now the American people have been struggling to free themselves from the incubus of the spoils system, and they are still in the midst of a long seige to force the final capitulation of the enemy. In this seige managers are the oftentimes brilliant commanders of the shock troops. They are necessarily in the front line trenches, where they have to deal with the assaults of the spoilsman day by day and night by night. On the whole my observation is that they are advancing the cause of good government in this direction more effectively than the executives of cities not enjoying the manager form of government. To be sure, they are usually the beneficiaries of a preliminary successful battle against the old type of city politics which was responsible for the inauguration of the manager form of government, and which secured their appointment as chief operating executive of the city. The manager's task becomes one of consolidating the ground captured, resisting the counter attacks of the enemy (which are sometimes ferocious enough—witness Knoxville), and teaching the lesson of good government.

The historian of municipal government cannot fail to give credit for achievements in this regard. But I pass on to note that managers have also performed a great work in establishing the same degree of care in public expenditures that are expected as a matter of course in private or personal business.

The remarkable achievements of President Coolidge and the Bureau of the Budget in hammering down federal expenditures are surely equalled in many of the manager cities. Perhaps no single item stands out so clearly

from my coast to coast survey of their work as the uniform care in spending money. Many managers have developed elaborate systems of visible ledgers, reports and accounts, which aid them in this respect, but the important thing is the will to exercise care. Their subordinates not infrequently tell me, after some preliminary skirmishing, that "you would be all right if you were not so damned tight." I do not need to add that the measure of managerial success is not the amount of money that is not spent but rather the results secured in the money that is spent.

In another direction also managers may rightly claim distinction. The indefinite term of office which they enjoy (or at least possess) permits them to indulge in what I suppose is the chief joy of the administrator, long time planning. Managers are doing more long range planning and better planning than are the mayors or city commissioners. Some of this is elementary common sense (through streets, in place of pavements before the alderman's residence), but some of it involves constructive vision of the highest order.

City Management as a Profession.—Finally, may I note the code of ethics, which indicates to me that managers are on the way to make of their calling a profession. The implications of this are literally without limits. Fundamentally I suppose it means a constant capacity for improvement of managerial technique by means of the continuing restatement and refinement of aims and methods. But also it assumes a steady supply of young men trained in the body of knowledge peculiar to the profession who can eventually carry on in their place. I am not sure that managers are taking enough action as an association either (1) to recruit their share of the best brains of each generation, or (2) to put down in black and white the body of knowledge which is evolving in the course of your work. May I suggest the desirability of preparing in the immediate future a manager's manual of standard practice in which would be described briefly but specifically the best methods of handling the many phases of work so far as you can now agree upon them; and where disagreement as to the best method exists, stating the alternative methods which have been found useful. The value of such a manual would seem to be very great, partly as indicating systematically for the first time what manager's methods are, and partly in providing help for the younger members of the profession, with regard to whom the older men have very important obligations.

City Managers and Art of Management.—The most important failure which has come to my attention is the lack of inventive power among managers to develop the art of management. This seems the more remarkable on first sight, in view of the fact that you are above all managers, engaged day by day in the duties of management, and in the larger cities at least, faced with all the problems of management in their full complexity. Later observation has provided me with some explanation of what was at first almost incomprehensible, but first let me define more exactly what I have in mind.

Management was first conceived in terms of mechanical adjustment, and the scientific management movement was chiefly concerned at the outset with strictly engineering problems. Perfection of plant, proper supervision and testing of output, the most effective routing of materials, the most complete adjustment of one part of the plant to another, were among these early objectives. Soon the management of finance became a major objective as well, and in public affairs this led into the realm of budget making and fiscal control.

Eventually it became clear that the ultimate hope of efficiency and the real test of good management was concerned with the proper handling of the human resources upon which business and government alike depend. Personnel management rapidly forged to the front and now absorbs the attention of a wide variety of specialists who are employing the technique of the scientific laboratory in large measure to evolve constantly better devices to achieve their major objective. Put in a single sentence, this may be phrased as follows: The purpose of personnel management is to bring out and capitalize for the benefit of any organization, public or private, the complete potential resources of the men and women who comprise the organization, with proper attention to the welfare of the workers themselves.

Much has been done already to reach this goal. In public affairs, we may note, first the merit system, which in one form or another is characteristic of the manager cities; second, the classification of positions to secure reasonable justice as between employee and employee; third, provision of retirement pensions; fourth, specific devices to stir up esprit de corps, enthusiasm, pride in the service, and the like; fifth, establishment of joint councils representing the employees and the city authorities for the discussion of conditions of employment. Of these, the merit system long antedates the manager movement, classification originated in a non-manager city and is widely in use in all types of city government, retirement pensions are the exception rather than the rule in the manager cities, plans for developing esprit de corps are almost entirely lacking in manager cities, and I know of no

city manager town which has developed anything like joint councils.

Nor does perusal of the proceedings of the City Managers' Association and the pages of the city manager magazine indicate that city managers are keenly alive to the importance of these phases of management. At some periods in the history of the association, one gets the impression that these outlets for manager's ideas were chiefly devoted to stating that so many miles of pavement and sewer had been laid, so many pieces of fire apparatus purchased, and so many arrests made with a total saving to the city of so many dollars. I would like to express my opinion that these events, while of importance to the city over whose destinies you keep guard are not the matters which ought to hold your exclusive attention. The really important question is, how do managers get their results? What are their methods? What is their technique? What they have done is a matter of interest to their city; how they did it is a matter of interest to all cities and to their profession.

I can illustrate my point by reference to a single problem of good management, which arises wherever a substantial body of men and women are employed, the problem of maintaining a high morale. The experience of the army during the world war, and of progressive industrial concerns since the war will guarantee the pertinence and the importance of the subject. A considerable number of well recognized devices are now at hand to deal positively with this problem. Examination of the city manager magazine and conversation with many managers and many of their associates convinces me that the managers, as a whole, are either unaware of or indifferent to these devices.

What this seems to indicate constructively is the development or enlargement of a staff agency which would be chiefly concerned in collecting, describing and publishing for the benefit of the managers at large the methods which have been found most effective in cities of different population classes. I believe that not until there is such an agency will the full benefits of the association and the profession be achieved.

I do not discover that many managers are members of the American Management Association, nor do I find on their desks the Journal of Public Administration, nor the Journal of Personnel Research. It is perhaps significant that the Assembly of Civil Service Commissioners has its staff agency, The Bureau of Public Personnel Administration, to assist it in grappling with its special phase of administration, while the City Managers' Association, inherently endowed with much greater promise as a professional unit, has not yet made this advance. In short, my observation leads me to believe that managers are on the alert to adopt the best methods, but that they are not so successful in inventing new methods.

Why City Managers Do Not Invent New Methods.—Adequate reasons exist for this state of affairs, and in a summary way I would like to suggest some of them. In the first place, many managers have never had the occasion or necessity to consider management in a comprehensive manner. They are mostly engineers, some business men, some professional men, some accountants, some military or naval officers, even a few teachers. They have been pitchforked for the most part into an extremely engrossing job which has occupied every waking moment with insistent problems which had to be met at once. Leisure to contemplate the larger aspects of their work has been a golden will-o'-the-wisp, always just out of reach. Moreover, most managers are engaged in managing the affairs of cities of less than 25,000 population, which, however exacting on the manager, do not present at all, or present only on a small scale, many of the problems of management. Many are not professional managers, but rather men who have been drafted to take over the affairs of a city, with no thought that they will ever be concerned with another city. Many have been concerned with the affairs of one city only or at most two. And finally one must always remember that the city manager movement is only 18 years old, and the oldest manager in point of service (but one of the youngest in spirit and enthusiasm) has had less than two decades of service. Then, too, as managers well know, they have always to consider how far they can go in their community in advancing the methods of conducting city business before they arouse hostility on the part of the citizens. Requiring applicants for the police or fire department to take the army alpha test, or advocating the interchangeability of county, state, and city personnel in order to open up channels of promotion might be less hazardous than removing dusty portraits from the city hall (witness Fort Worth), but then again, it might not.

Personality Classification of City Managers.—Parenthetically, at this point may I say that I have been trying to discover if there is a personality pattern which seems to make a success of city management, and another which fails at the job. My present belief is that there is no single personality pattern which predicts either success or failure. Most managers would be classified by the psychologists as extroverts, but within this classification I can find many combinations of personality. Some are aggressive, others are not; some

are diplomatic, others are not (if I can believe common report); some are sociably inclined, others are the contrary; citizens who enter some managers' offices depart purring, others spitting, but in either case the manager seems to hold his own; some speak fluently and freely, others refuse to make a public speech, and if I can believe what I hear, others ought not. In short, psychologically, managers do not run to type, and I am inclined to believe that their success is due more to public confidence in their motives and ability than to any magic mixture of traits of personality.

Public Relationship of Managers.—Returning now to the main thread of my narrative, may I briefly present some reflections on various phases of the managers' public relationships. Managers are faced with one set of duties toward their city councils, with another toward the public, with another toward the local political parties, and with another toward the technicians who carry on the work of the departments. They are beginning already to standardize their attitudes toward these relationships in the code of ethics; but as I am interested in looking behind the terms of charters and ordinances, so also I must search behind the code in order to catch sight of the stark facts.

The importance of an able city council to the effective prosecution of your work no one understands better than the managers. It is my conviction that the general level of efficiency of city government is certainly as much dependent upon the city council as it is upon the manager. I am also thoroughly convinced that most city manager cities get better government during the first years of the new plan than they are entitled to, and that no conclusions concerning the superiority of the manager plan should be made until the first few years have passed. What happens is perfectly clear, and generally understood; a revolution against the mismanagement and sometimes corruption of politician government results in aggressive leadership by the business men of a city for a new deal; looking about for some guarantee of better government; these business men are captivated by the resemblance between their corporation and the city manager form of government; they put over the city manager plan, and then go into the first campaign for city council and elect their representatives. At the end of two years, or perhaps four years, these men have to get back to their business. They say, "We have turned our trick, let somebody else do it." At about that moment, some of the old gang pop up and are not infrequently elected to the council, with trouble in the offing for the manager.

The Council Weak Spot in City Manager Cities.—The most dramatic confirmation of this almost universal tendency is to be found in recent events in Knoxville, but from one end of the country to the other, the weak spot in the city manager cities is the council. The decline of the council provides some difficult problems for the manager. Shall he sit still in the face of ruinous measures proposed by the council? Shall he confine himself merely to observations before the council? Seeing the possible election of unfit men to the council, shall he enter the lists against them, as was done by the manager of a certain western city? How shall he protect himself and the administrative service against their demands for jobs? Or, what most commonly is the case, sensing the total lack of constructive ability in the council, and sincerely desirous of advancing the interests of the community, shall he, indeed, must he not, make himself the spokesman for great issues of municipal policy? At best it is clear that the manager necessarily does associate himself with issues of public policy; his duty to advise the city council makes escape impossible, even though it were not also true that usually he is the most competent individual by virtue of his superior training if not ability.

These problems have often been discussed by this association, and I have no new solution to offer. At most may I offer my observation that on the whole, in spite of certain notable exceptions, the managers seem to hold the center of the municipal stage, and seem not to find themselves uncomfortable in that position. The problem of effective community leadership is one of the most urgent, and one of the most difficult facing our American municipalities today, and I must say that the presumption of the city manager charters, that leadership will be forthcoming from the mayor or the council, hardly seems to be warranted by the facts.

So far as the public is concerned, little need be said. I have been often surprised to observe how completely managers place themselves at the disposal of the public. At any hour of the day, Mr. Ordinary Citizen may present himself at the manager's door and be heard. He calls the manager on the telephone about matters which no business executive would allow to come to his attention, but which the managers' position makes it desirable to hear. But at the same time, I feel that the managers' larger duties to the community must occasionally suffer, for the margin of free time in which they do their thinking about the city of the next years must be pitifully small.

Citizens Advisory Committees Important.—Many managers are active in tying the public in to the city hall through citizen advisory committees. While this is not always possible and not always successful, I cannot help feel-

ing that this is a most important device. Our municipal governments must not only be efficient, they must also conform broadly to the ideas and wishes of the people. As an instrument for education of the manager and the people alike the citizens' committee may play a useful role.

The City Manager and Local Politics.—The managers' relations to the local political parties are not wholly of their own making. But so far as they have freedom, I discover that they take seriously their obligation to serve the whole city, without a special obligation to part of it. To be sure, I am acquainted with city manager cities in which the manager and the political potentates are on close terms, and in which the machine gets what it wants. Of these cities it must be said that the promise of the city manager movement is not and can not be fully attained. In saying this I am not criticizing the manager so much as I am casting reflections upon the citizenship of the community which elects councilmen who will tolerate this type of government, which happily is passing into the discard. One of the most surprising discoveries of my journey has been the almost complete disappearance in the small and medium sized cities of the old style political machine, a consummation which certainly moderates the difficulty of the managers' profession. Looking the country over, I can only conclude that they are playing the game four square in their determination not to allow politics to control their decisions as managers.

But whether the general strategy of their position will enable them to remain clear of the political life of their community remains an open question. They wield enormous power, not merely in the appointments which they make and which others are eager to control, but also in their influence upon the policies of the community. Certainly on any theoretical grounds one would be justified in asserting that inevitably they would be drawn into politics, at least to an extent that they rise and fall in accordance with the success of failure of their policies at the polls. It is not enough to say that they have no policies; they do, and they would be poor managers if they did not. Nor does it seem enough to say that their policy becomes the policy of the council when it appears on the campaign platform, for the manager usually stands head and shoulders above the council. In spite of all this, in many cities the seemingly impossible occurs, and managers steer clear of local elections and local politicians.

The City Manager Type or Strong Mayor Type.—Superficially, the city manager type of government seems to be firmly established. Looking into the hazards of the city manager's position, however, I wonder whether the manager type will survive or be gradually transformed into something resembling the existing strong mayor type. The manager plan has nothing to fear from the commission type of city government, but the battle between the mayor type and the manager type is not yet won. The mayor type has, it seems to me, the indisputable advantage of providing more successfully for effective community leadership, and if it can also give reasonable assurance of good administration (as in Milwaukee, Detroit, and other cities) there is a possibility that there will be a steady drift away from the city manager type. If the manager is forced by the weakness of the city council to take the leadership in determining the policy of the community, or if his own aggressiveness places him in that position, or if the sham of his concealment behind the council is penetrated and people understand that it was the manager's influence that settled a given program, then he must expect to rise and fall on the results of his program at the polls. Events in Phoenix, Ariz.; Pasadena, Cal.; Waltham, Mass., and other cities indicate that this may happen. If it does happen generally the demand will soon be forthcoming that the chief executive shall be elected directly by the people.

Local Man Preferred for City Manager.—Another factor also indicates a tendency to swing back to the strong mayor type of city government, to wit, the preference for the local man as against the outside man. In our files we have records of 905 appointments to managerial offices from which it appears that the first appointment to a manager city gives 56 per cent outsiders and 44 per cent local men, but the second appointment gives 38 per cent outsiders and 62 per cent local men, a proportion which is roughly maintained in later appointments. If it appears that these local appointments are promotions of understudies from within the ranks the matter is not so serious. A preliminary tabulation indicates that about 40 per cent of the local men are in fact appointments from within the service. These figures are therefore far from conclusive in indicating the preference for the local man, not a professional; but they do reflect what is clear to the observer, the extraordinary provincialism of most of our American cities. This instinct for the local man is of course justified if the manager is to play the role of the community leader; and if it appears that this role is forced upon him, the logic of the situation is clear enough.

Length of Service of City Manager.—Still another bit of evidence bearing on the point is the average length of service of the manager. The hypothesis is that the city will benefit by continuous service of the manager who is not subjected to the changing tides of

local politics. The facts seem to indicate the contrary. Records of 839 managers in 355 cities, all of which now have the manager plan, indicate that the average term of office is slightly over two years and six months, which does not compare favorably with the four-year term frequently enjoyed by mayors, with the possibility of re-election.

What the outcome of these facts will be is of course problematical. My only point here is that the tendencies do not wholly confirm too confident a view that the city manager type of city government is destined to become universal unless (1) adequate provision can be made for effective political and community leadership, (2) even more notable advances can be made by the managers in the art of management, (3) the tide in favor of the local man can be stemmed, (4) reasonable continuity of service can be obtained, (5) a constant flow of capable men can be attracted into the profession.

To raise these questions about the future evolution of the city manager plan is in no way to disparage the excellence of the government which managers are now providing in over 350 cities. There can be no doubt that they have made a notable contribution to American municipal institutions. The failure of the manager plan in some cities is no reflection upon the plan, and usually not upon the manager; it is primarily a demonstration of the power of local political machines fighting desperately and for the time successfully to retain the system from which they derive their very existence. If the public opinion of a community will not support intelligent, competent government, no manager and no form of government will be able permanently to produce satisfactory results. But in the development of an intelligent public opinion determined to secure honest, competent municipal government, the city manager plan is playing a leading role. The friends of good government can only wish for its rapid extension throughout city and into county and state governments.

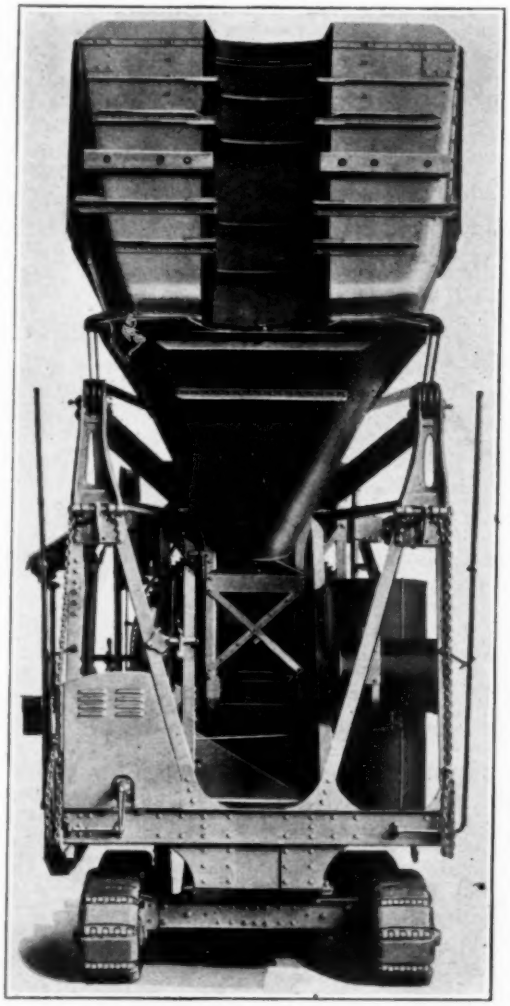
Special Skip for Center Joint Paving

A special skip for center joint construction which is furnished optionally with the 27E paver of the Koehring Co., Milwaukee, Wis., is illustrated.

An arch with a clear width of 24 ins. is built into the center of the skip. With this liberal clearance for the center joint, the skip comes down flush to the subgrade, allowing the batch trucks the use of the skip without interference, the same as with the standard skip.

The Koehring Co. meets another special condition with a narrow skip, measuring 90 ins. on the outside and 85 ins. at a point 4 ft. from the end, which is often found necessary in narrow width paving.

Clearing low bridges, wires, or other low overhead obstructions is accomplished by a specially designed overhead frame. Another important feature of the Koehring 27E paver is the adjustable traction width of the multiplanes. The standard width of 90 ins. overall can be readily changed in the field to 82 ins. by a few simple adjustments. Likewise the operator's platform can be reduced to conform to the narrow traction. The canopy and tool box are so designed that they will fasten to the remaining section of the platform.



Koehring Special Skip for Center Joint Construction

Gravel Road Construction in Alberta

Methods and Costs Given in Paper Presented Sept. 30 at 13th Annual Convention of Canadian Good Roads Association

By C. A. DAVIDSON
Chairman Good Roads Board, Edmonton, Alberta

We have divided our gravel research into three areas, known as the Prairie, Foothill and Mountain, and we find that generally speaking we locate our material least where we require it most.

Prairie Gravel.—Prairie material, with very few exceptions, is difficult to locate, being generally high in overburden. The class of material also varies, being of a sandstone type with very little binder. A few pits contain a low percentage of calcium carbonate, but this material is generally interspersed with a fine sand of doubtful surfacing quality. We have very little to enthuse over on our prarie pits and the perfect one is still to be located. A few of the principal disadvantages of this material are:

Too much clay in silt; layers and pockets of fine sand; not enough binder; non-durable stones and weathered material; seams of coal and other impurities; too much oversize material; heavy and extensive overburden.

Prospecting for this material is so far confined to areas within reasonable haul limit from our road locations, and the work comprises mostly a survey of likely places, based on physical conditions prevailing. In this we do not even neglect the humble gopher, to whose doubtful sphere of usefulness we must add his burrowing habits, which have on occasion resulted in a gravel find.

Foothill District Gravel.—Coming into the foothills we find our material changing for the better, with our pits of more frequent occurrence. Limestone replaces sandstone, the pits are more accessible, being laid on something approaching a workable face, sand is coarser and disintegrated limestone particles of value are encountered. Through foothill country, pits are more readily obtainable, due to there being less agricultural activity, which on occasion simplifies the problem of obtaining possession.

With two of our transprovincial highways partially in the mountains at Crow's Nest and Kananaskis, both routes being subjected to heavy traffic, we have made extensive searches for suitable surfacing material and find nature for once in her generous mood, providing granite, limestone, shale with lots of binder and a prodigality of suitable locations. The varying materials found sometimes require mixing, particularly where surfacing is being done through solid rock excavation, but the material can always be economically found at short-haul distance.

In conducting our search for material, we have so far limited our work to sections close to our main highway system. Under our agreement with the Dominion Government as provided by the Canada Highways Act, we state that the proposed type of construction will be an earth double and single lane highway with gravel and sand clay surfacing to be undertaken wherever possible by the following governing conditions:

(a) Proximity to suitable material.
(b) Demands of traffic.

Thus it is, that for the present program, which should be completed by the end of the working season of 1927, we hope to finish gravelling on the following main highways: Calgary-Edmonton, Calgary-Glacier Park, Crow's Nest-MacLeod, Lethbridge-Coutts, and Calgary-Kananaskis, the latter being already completed.

Preparing Subgrade.—Prior to the placement of material, however, has been the initial work of preparing subgrade for the reception of material, this work being commenced in 1924. The major portion of our work being on the plains, the preliminary work demands close attention to the choice of route, consideration of drainage, gradient and alignment. Soil conditions, especially in relation to the surfacing material available, is also an important factor, and thereby occupies an important place in our preliminary engineering work. In the agricultural sections of the province we are limited to our road allowances for our locations, the only changes being of a minor character at intersections where curvature has to be modified to meet the requirements of modern transportation.

Our standard roadway is 20 ft. in width, and 22 in embankment over 5 ft. in height or where protection work has to be installed. Our average quantities in earth construction is approximately 4,500 cu. yd. per mile and the average cost of one mile of completed earth road, including culverts, rip-rap and other incidentals is $2,280. This represents the initial investment in gravelled roads and is by far

the most important part of our work, inasmuch as a surfaced highway can only be as good as its foundation will permit. This work is exclusively performed by contract.

Maintenance Period.—Following the completion of our earth construction, the road is turned over to our district engineers for maintenance, as we allow a period of time to elapse between the completion of grading and the commencement of surfacing. No stated time is given owing to the varying considerations of types of soil, intensity of traffic and weather conditions prevailing. It is the exception rather than the rule, to find our surfacing proceeding in the same working season in which earth construction has been done, as we certainly obtain better results by allowing the natural process of shrinkage to develop and to permit traffic to wear down and compact our grades. This is particularly desirable in the case of soil of the heavier type, such as is encountered in the central and northern sections of the province.

Gravel Surface.—Next follows the calling for tenders on gravelling, which has as its basis material and access thereto furnished by the department. The material may be screened gravel or oversize crushed, dependent upon the mechanical analysis of the pit, which is compiled as follows:

(1) Estimate of average composition of pebbles.
(2) Relative proportion of same.
(3) Relative proportion of various sizes.
(4) Quantity of clay, silt or other binder.
(5) Notes on impurities.

We do not, in every instance, crush our oversize material. While all material shall not exceed 1½ in. in a circular screen, we do not proceed to crush material over that diameter unless the pit develops more than 25 per cent oversize. Should a large quantity of material be required, such as a contract recently completed at Blackfalds calling for 80,000 cu. yd., we naturally make use of all material handled by putting everything rejected by the screen through a crushing and mixing plant. Our experience in this connection has been that to encourage a contractor to put in a proper plant for highway gravelling, you must offer him the inducement of larger contracts, if reasonable bids are to be assured. Material may be hauled direct from the pit to the roadbed or taken from stock piles placed at railway sidings. The varying units of bid are as follows:

Preparation of subgrade per Sta. 100 ft. This work includes the grading and filling of the earth roadway true to cross section, which allows 0.1 ft. of crown over 20 ft. roadbed. The roadbed is therefore practically flat at the time of gravel being placed. Excavation, screening, loading and, if specified, crushing oversize material is included as one operative bid at a unit price per cubic yard, loaded either to wagons, trucks or railway cars. Stripping is paid for on the basis of excavation per cubic yard and rejected material is paid for on the same basis of stripping. The next bid price asked is for hauling, spreading and finishing gravel surface in two courses, the unit of bid being per cubic yard mile. Haulage commences at the pit, and is computed on the average haul over a given mileage to be surfaced. Our first course is laid to a depth of 4 in. at center line, to zero 10 ft. right and left, and the second course, which is not applied until consolidation of the first course has been obtained, is laid to a depth of 2 in. at center line to zero 8 ft. right and left. Our total quantities per mile of road amount to 1,240 cu. yd. in place, although in certain instances, second course placement has been reduced to provide stock piles for maintenance purposes in an amount not exceeding 100 cu. yd. per mile, which is, roughly, two cubic yards per station.

Gravel Compacted by Traffic.—We do not call for sprinkling or rolling in our gravel as we rely entirely on our gravel being compacted by traffic. This is a subject of considerable local contention, especially during the first season's traffic, when it cannot be denied that the roadbed offers additional hazards to motor traffic exceeding a speed of, say, twenty-five miles per hour. Our experience has been that consolidation has been rapidly obtained, one instance of which is on our gravelled road between Calgary and High River, which, completed in the summer of 1925, has already been scarified by our maintenance crew, as the roadbed was so firmly compacted that additional material would not set in worn sections of the roadbed.

The average cost per mile of gravel placement is at present $3,100 with an expectation of costs to rise as the length of haul increases, as we have naturally concentrated on placement of material where readily obtainable and have already practically exhausted our short haul movements.

An important feature of our work enters here and concerns the vital question of conservation of our material for the requirement of maintenance. We consider it a sound practice to pass up pits of limited yardage in preference to a location where although the haul may be longer, a sufficient yardage is assured. By this means, gravel deposits of limited quantity are preserved for maintenance purposes. The question of reserve supplies also enters into our action in preferring purchase of a pit on an acreage basis against allowing an owner a certain sum per cubic yard for material used. In this we are not always successful,

as several gravel deposits, especially near towns, have commercial value for purposes other than roads, and we naturally are not enthusiastic about expropriation proceedings although that measure has been necessary on one or two occasions.

At present we have 70 known deposits of gravel suitable for main highways work, of which 14 are operated on a yardage basis, payable to the owner. Nineteen pits have been acquired and are held in reserve for maintenance purposes and 37 pits are owned and operated by the department.

Unit Prices.—An analysis of unit prices since the commencement of our work by contract, reveals some interesting figures, the following summary being compiled from the working seasons of 1925 and 1926:

Preparation subgrade, per 100 ft.	$0.37
Excavation, screening and loading, per cu. yd.	.41
Excavation, screening, crushing oversize, mixing and loading, per cu. yd.	.80
Loading gravel from stock piles, per cu. yd.	.23
Hauling, spreading and finishing:	
From pit, per cu. yd. ml.	.45
From stock piles, per cu. yd. ml.	.40

Our average haul from pits or railway sidings is 2.5 miles and motor truck transportation is almost exclusively used. At the inception of our work, teams with dump and converted wagons were used, but as length of haul increased, our contractors became more partial to motor truck transportation. Practically every contractor has his own ideas as to the type of vehicle employed, but the two and one-half to three-ton dump truck, equipped with pneumatic tires, is at present the most popular. In our standard specifications we limit the load carried on the basis of width of tire, both for horse and motor haulage, although the clause is not considered to be very drastic. The clause is as follows: "Motor trucks used in hauling shall not have a loading in excess of 600 lb. per inch width of tire, including the weight of truck as well as of the materials being transported, and no wagon hauling 1 cu. yd. of surfacing or more shall be permitted on the work with a tire width of less than 3 in."

The maximum load for a truck equipped with 6-in. front and 8-in. rear pneumatic tires would be approximately 3½ cu. yd. of gravel. We encounter some difficulty in enforcing a clause in our specifications, directing that wagons and other vehicles engaged in haulage of material shall break wheel track over the surfaced section of the roadbed. The observance of this clause, especially when the roadbed is wet from rainfall, aids us considerably in obtaining rapid consolidation of our first course placement. Excavation and loading methods are of a varied character throughout Alberta, this condition being due to there being hardly two pit locations of a similar type. Varying quantities of material to be excavated also govern the selection of equipment. One notable feature is apparent and that is the inclination on the part of our contractors to provide themselves with reliable plant. Some of our initial work brought forward a weird assortment of excavating machinery which suffers in comparison with the types now being used by one or two of our more reliable bidders. Effective plant arrangements, especially when we are faced with a short working season, should be a determining factor of considerable importance when tenders are being reviewed.

All work performed is under the supervision of qualified engineers, who are responsible for the computation of month end estimates, the acceptance or rejection of material, its mixing if necessary and its proper application on the roadbed.

Preliminary Information.—Another point which has a considerable bearing on a contractor's attitude to our work is in the accuracy of preliminary information. It is for this reason that we attempt to provide the fullest possible information on the class of material to be excavated and indicate on accompanying haul diagram the nature of the service road between the pit and the highway and also in providing an accurate statement of cubic yard-mile haul. This is quite important and I have no doubt influences the bidding to a considerable extent. One cannot stress too strongly the economy of a thorough examination into the sources of supply and the transference of the findings into the fullest possible information on the form of tender.

In Alberta we employ an engineer exclusively on the work of research and whose additional qualifications permit his being able to conduct survey and agreements on the ground for the purchase of a prescribed acreage or yardage, as the case may be, thus completing the entire negotiation with the exception of payment.

Texas Limestone Rock Asphalt

Dean F. C. Bolton, director of the Texas Engineering Experiment Station, A. & M. College of Texas, has announced the publication of Bulletin 31, styled "A Study of the Fluxing of the Bitumen Contained in Texas Limestone Rock Asphalt," by J. T. L. McNew, professor of Highway Engineering at the A. & M. College of Texas.

This publication discusses in detail the characteristics of various fluxes used with Texas rock asphalt on pavement construction in the state, and shows by means of numerous curves and diagrams the amounts of flux necessary to produce the most desirable paving mixtures.

Copies of the publication may be obtained upon request to Director F. C. Bolton, Texas Engineering Experiment Station, at College Station, Texas.

The Vehicle and the Road

Editorial in Chicago Journal of Commerce

Henry Ford said a long time ago that if the American people got automobiles, they would get highways as a natural result. And the prophecy has proved essentially true. Not only that, but it was bound to prove essentially true. A well-known English author, Hilaire Belloc, demonstrates in a recently published book, 'The Highway and its Vehicles," that the nature of the vehicle has always determined the nature of the highway.

When man walked afoot, and became accustomed to making a given journey, his feet made a path. When he rode a horse, he clung to the path. But when he put himself into a vehicle, at once width was necessary. "What made the road in general," writes Mr. Belloc, "was man's necessity of passing from one point to another; but what made the highway was the vehicle." The nature of the highway was determined by the nature of the vehicle. And Mr. Belloc declares "that is why the 'covered wagon' has given its name to the big movement across the plains to the Rocky Mountains."

When two persons rode in a vehicle, it was natural that they should desire to sit side by side. This desire gave a width to the vehicle at a very early stage in civilization. The width was approximately between five and seven feet. It was necessary, in the first place, that highways should be wide enough to accommodate such a vehicle. And in the second place, it was necessary that highways should be, at the very least, wide enough to permit two such vehicles to pass one another. Accordingly from ten to fourteen feet became the minimum width of a highway. A trifle more leeway is given in the United States by the ordinary eighteen-foot road.

Not only width, but the nature of the road surface, has continually been determined by the nature of the vehicle. Always the vehicle has been bought or constructed for individualistic reasons, to suit the owner's desires. Having the sort of vehicle that has suited him, he has insisted that society supply him with the sort of highways which will permit him to travel farthest and fastest with greatest comfort and at least expense. And society has responded to the pressure of the owners of vehicles.

The coming of the automobile has brought so great a change in highway travel and highway necessities that there is perplexity as to the best methods of adjustment. Mr. Belloc suggests, as has sometimes been suggested by Americans, that swift and heavy motor traffic be confined to highways specially constructed. He would have these highways laid out at such intervals and in such places as would suit the needs of the greatest number.

"Get the automobiles and you will get the roads," said Henry Ford. And the prophecy has proved essentially true. Of course the congestion of the present highways does impede the purchases of automobiles; but the impediment is comparatively slight. If there were better roads, more automobiles would be bought. But essentially it is true that the road is caused by the automobile, not the automobile by the road.

Suppose at the beginning of this century the country had been rich in splendid highways, two hundred feet wide; and suppose also there were then no automobiles. Would the existence of those highways have caused the invention of the automobile? Surely not. But the existence of the automobile, and the increased purchases of the automobile, forced the country into an era of highway-building. The vehicle determines the nature of the highway.

Oiling Clay Roads

As an experiment, 8 miles of clay road near Pine Grove, Amador County, Calif., was oiled in an attempt to keep the surface in good shape. The oiling was done when it became apparent that water holes were drying up so that the road could no longer be sprinkled. An application of approximately 1/5 gal. of 14+ fuel oil to the square yard was placed early in July. The road soon became dusty in spots, but held up well in other places. A second application of the same amount of oil was placed except where the first application was sufficient.

The August issue of California Highways states that from present indications, this second application will keep the road in good shape for the balance of the season. It is necessary to drag the surface frequently to keep it smooth and free from pot holes and oil cake.

Variety in the Daily Grind

It has been the practice in the Engineering Department of Borough of Manhattan, New York City, to adopt, where possible, modern business methods, not alone in conducting engineering operations but in making the environment of the employees as interesting and pleasant as possible. One of the practices is to provide a variety of work in the engineering division for each employee by either assigning a different kind of work to him from time to time or, in the case of the draftsmen, transferring them from one kind of work to another as the work permits.

The Relative Roughness Determinator

An Instrument Developed by the U. S. Bureau of Public Roads for Measuring Relative Road Roughness

The general appreciation of the importance of road surface smoothness by highway engineers has created a demand for an instrument with which the roughness of a road surface may be measured. With such an instrument the engineer would find it possible to specify the quality demanded in new work and to obtain accurate data on the deterioration of the surface in time to apply proper corrective measures. To be most useful such a device should not only be accurate but should supply the information rapidly and in such form that it can be used immediately. Finally, it should be mechanically simple and reliable and so designed that it can conveniently be used on an automobile.

Several devices have been offered from various sources to meet the demand. The Bureau of Public Roads experimented with a number of designs over a period of several years and finally, in May, 1925, developed one which when then used in the vicinity of Washington, D. C., appeared to be better in several respects than other available instruments.

Subsequent use of this type of instrument over a considerable period of time in several states by a district engineer of the bureau indicates that it is entirely satisfactory for the purpose. It is, therefore, with considerable confidence in the worth of the instrument that a description is now presented.

How Roughness May Be Indicated.—There are a number of ways in which the roughness of road surfaces may be indicated by an instrument attached to a vehicle, but the fundamental principle upon which all of them depend is that the vertical motion imparted to the vehicle by the irregularities in the road surface bears a direct relation to the degree of roughness. In order that the effect of this motion upon the chassis of the vehicle may be minimized, body springs and rubber tires are provided, the deflection of which absorbs much of the undesirable vibration. The magnitude of these deflections depends not only on the magnitude of the road roughness but also on the speed of the vehicle, amount and distribution of the load, and the type and condition of the spring and tire equipment. By maintaining constant all of these other conditions, the deflection of the body springs may be made to measure the relative roughness of the riding surfaces over which the vehicle is driven. This fact furnishes the principle on which the relative roughness determinator or roughometer, as it has been called, operates.

The Relative Roughness Determinator.—Briefly, the roughometer* consists of a rack which is attached in a vertical position to the front axle of the vehicle. Meshed with this rack is a spur gear which is supported by the frame of the car. Movement of the front axle with respect to the chassis, caused by deflection of the body springs, thus produces translation of the rack and rotation of the gear. This gear is connected through a flexible shaft to a mechanical counter on the instrument board of the automobile. Deflection of the front springs of the vehicle thus causes the rotation of the spindle of the counter. In order that this spindle will not rotate in the reverse direction when the body springs return from their deflected position a ball clutch is interposed between the gear mentioned and the flexible shaft which operates the counter. This ball clutch allows the flexible shaft to turn in only one direction so that the counter operates only during deflection of the body springs and thus records the summation of these deflections during the time the instrument is in operation.

Distinct Features of Instrument.—1. It can be attached to any automobile without impairing the appearance or the normal operation of the vehicle. 2. The data are presented as abstract numerical factors which can be used immediately. 3. Satisfactorily accurate data can be obtained at normal highway operating speeds so that there is no interference with or from traffic. 4. The instrument can be thrown completely out of operation when not in use, thus preventing excessive wear of its moving parts.

Referring to Fig. 1, which shows how the instrument is mounted on an automobile, it will be seen that it consists of two distinct parts; that is, the rack and ball-clutch mechanism which is mounted on the engine block or chassis of the car, and the recording mechanism which is permanently mounted on the instrument dash.

Use of the Instrument in the Field.—The various parts of the instrument are so designed that a movement of the rack of 1 in. records one unit on the counter. While it is possible to calibrate the instrument in terms of abso-

* A full description of this instrument appears in the September issue of Public Roads.

lute surface profile, this calibration is difficult and of no practical value. The purpose of the instrument is to indicate the relative roughness of various surfaces or the changes in roughness of the same surface over a period of time. It is only necessary, therefore, to standardize the speed, load, spring and tire conditions of the vehicle on which it is to be used and the device will be ready for service. Care should be taken to check the tire inflation frequently and obviously the speedometer on the car should be maintained in first-class condition.

Any normal operating speed may be used; but whatever the rate decided upon it should be maintained throughout the test, and the same speed should be used in comparative tests. It is desirable, therefore, to so set the speed that it can be maintained without interfering with or interference from the other traffic on the road. Table I gives values obtained on a section of pavement 1½ miles in length at three speeds. This table illustrates not only the effect of speed on the magnitude of the factor obtained but also the consistency of the results obtained on several runs over the same road.

Table I—Roughness Factors Obtained in Operation Over a Section of Pavement 1½ Miles Long

Three Round Trips at 25 Miles Per Hour			
Southbound	196	Northbound	173
Do	199	Do	168
Do	195	Do	170
Average	197	Average	170
Five Round Trips at 30 Miles Per Hour			
Southbound	225	Northbound	206
Do	224	Do	203
Do	227	Do	201
Do	230	Do	202
Do	225	Do	203
Average	226	Average	203
Three round Trips at 35 Miles Per Hour			
Southbound	242	Northbound	221
Do	242	Do	224
Do	246	Do	224
Average	243	Average	223

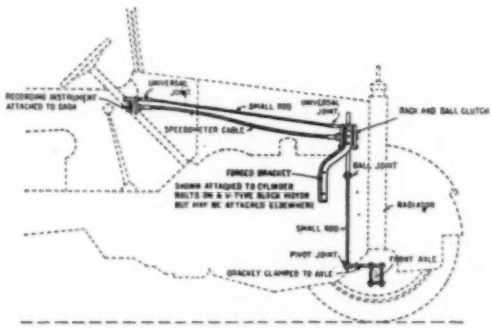
From these data it will be seen that the maximum deviation of any reading from the average of the group is considerably less than 2 per cent. It will also be noted that the increase in the roughness factor is a most directly proportional to the increase in speed.

Interpretation of the Roughness Factor.—The relative roughness of a road surface is indicated by an abstract number which is a measure of the total average accumulated compression of the two front springs of the vehicle in inches per mile. If the counter be set at zero at the beginning of a trip and the instrument is thrown into operation while the automobile traverses 1 mile of road surface, then the reading on the counter as the car completes this 1 mile of travel may be called the roughness factor for that particular mile of surface. Some idea of what a roughness factor of 100, 200, or 300, means may be gained from the observations following which are based on a heavy car driven at a rate of from 30 to 40 miles per hour:

Roughness factor:	Motion of Vehicle
Less than 80	No perceptible vibration.
80 to 110	Slight vibration.
110 to 150	Noticeable vibration and slight lurching.
150 to 200	Disagreeable vibration and noticeable lurching.
200 to 300	Disagreeable lurching and somewhat dangerous for light cars at high speeds.

The magnitude of the roughness factor obtained on various types and conditions of road surfaces has been shown to vary somewhat with the auxiliary equipment used with the roughometer.

Measurements made in the vicinity of Washington, D. C., indicated a range of from 80 to 100 for very smooth pavements to from 250 to 300 for rather rough surfaces, while some results recently obtained in California with another instrument on another type of automobile range from about 60 for good concrete pavement to 250 for a rather rough oiled gravel.



Arrangement of Roughometer on Car

Roughness of Different Roads Compared with Roughometer.—A brief discussion of some of the data obtained last year by one of the district engineers of the bureau may be of interest. Forty-eight sections of concrete pavement, comprising 412 miles, and five sections of bitumionus topped pavement, comprising 59 miles, were measured. The average roughness factors found for particular sections of the two types were, respectively, 141 and 193. The average roughness factor for concrete pavements constructed prior to 1923 is 196, whereas that for those constructed during and since 1923 is 115, showing that very great progress has been made toward constructing smoother pavements.

Data on a section of pavement fairly typical of those constructed six or seven years ago are shown in Table II and Table III shows similar data for a section constructed in 1924.

Table II—Roughness Factors of 5 Miles of Concrete Pavement Typical of Those Constructed Prior to 1920

Mile of pavement	Roughness Factor	Mile of pavement	Roughness Factor
First	252	Fourth	229
Second	258	Fifth	349
Third	244		
		Av. for 5 miles	266

Table III—Roughness Factors of 13 Miles of Concrete Pavement Constructed in 1924

Mile of pavement	Roughness Factor	Mile of pavement	Roughness Factor
First	90	Ninth	85
Second	90	Tenth	82
Third	81	Eleventh	81
Fourth	84	Twelfth	*102
Fifth	*102	Thirteenth	83
Sixth	98		
Seventh	99	Av. for 13 miles	89.3
Eighth	84		

* Hills.

In each of three states it was noticed that the first mile constructed was generally the roughest mile in the section. The average roughness factor for the roughest mile in 48 sections in one state was 175 and of the smoothest mile 107, a difference of 68. This difference for 34 sections in another state was 65, and for 13 sections in a third state was 67. This would seem to indicate that very careful supervision should be exercised during the construction of the first mile of pavement laid and that as many first miles should be avoided as possible by awarding contracts early in the season and of such length as may require the entire season to construct. This well illustrates the importance of the roughometer or relative roughness determinator to the highway engineer.

Table IV presents data which show the greatly increased roughness in the first mile of construction.

Table IV—Roughness Factors, by Miles, on a 7-Mile Section of Pavement, Showing Increased Roughness in the First Mile

Mile of pavement	Roughness Factor	Mile of pavement	Roughness Factor
First	383	Fifth	115
Second	271	Sixth	126
Third	128	Seventh	156
Fourth	112		

In general, it has been found that a pavement is smooth or rough all the way across, although in a number of instances a consistent difference between the right and left sides has been observed. Table V presents data typical of such a case.

As indicative of how smooth pavements can be built, Table VI shows data obtained for the smoothest pavement found in two Midwestern states.

From data similar to that cited in Table VI, obtained on many hundreds of miles of roads the indications are that the instrument as described does give a true index of the relative roughness of road surfaces.

The data, which can be obtained quickly and at small cost, should be invaluable to highway officials, particularly supervisory officials who cannot hope to inspect every mile of pavement, as a basis for rating contractors, superintendents on force account work, engineers, inspectors, and all other directly responsible for the quality of the pavement. They will be found valuable even by the highway official who can and does visit all projects during construction, for they will furnish him definite data rather than opinions on which to base conclusions.

Table V—Roughness Factors on East and West Sides of a Pavement

Mile of pavement	Roughness Factor West Side	Roughness Factor East Side
First	81	89
Second	91	97
Third	88	89
Fourth	101	121
Fifth	69	77
Sixth	76	86
Seventh	74	84
Eighth	85	96
Ninth	89	97
Tenth	82	81
Eleventh	83	82
Twelfth	85	88
Thirteenth	79	81
Fourteenth	94	85
Average per mile	84	89.5

Table VI—Roughness Factors on Smoothest Pavements Found in Two States

(a) Mile of pavement:	Roughness Factor	(b) Mile of pavement:	Roughness Factor
First	63	First	60
Second	71	Second	67
Third	66	Third	60
Fourth	119	Fourth	63
Fifth	109	Fifth	57
		Sixth	63
Average for first 3 mi.	66.7	Seventh	59
		Eighth	62
		Ninth	59
		Tenth	68
		Average	61.8

Study of Bituminous Treatments

C. L. McKesson, Materials and Research Engineer of the California State Highway Commission, and a member of the Committee on Structural Design of Roads of the Highway Research Board, has been engaged this summer on an investigation being conducted in co-operation with the United States Bureau of Public Roads on the value of various bituminous treatments for crushed rock and gravel surfacing. The investigation to date has included projects in California and Oregon. B. A. Anderton, a member of the Committee on Structural Design of Roads of the Highway Research Board, represents the Bureau on this investigation. A study is being made of the construction methods employed on the several projects and the conditions of various treatments in order to select the most promising combination of materials and methods for further investigation. Later the studies will probably include records of maintenance costs of the various types of pavement.

Earth Road Construction in Saskatchewan

Methods and Costs Given in Paper Presented Sept. 30 Before Canadian Good Roads Association

By H. S. CARPENTER
Deputy Minister of Highways, Saskatchewan

If there is no further extension of the subsidy for federal aid, the Canada Highways Act is now a thing of the past in Saskatchewan, as by the end of 1925 2,000 miles of provincial highways had been built under the Canada Highways Act at a total cost in round figures of $5,000,000, this being sufficient to earn the entire subsidy alloted to Saskatchewan of $1,806,255. The province, however, is continuing this year to carry on its program of construction of its provincial highway system, and will add another 400 miles of completed road by the end of the present season.

Methods.—We are building our provincial highways to a standard width of 20 ft. of travelable surface. The grade is built up to at least 2 ft. above the maximum high-water mark, and side slopes of 3 horizontal and 1 vertical on all embankments 4 ft. and under. Where the embankment is higher than 4 ft., side slopes are reduced to 1½ to 1, and protected with a guard rail. The crown of the road for 20 ft. in width is 6 in. Particular attention is given to the ditches to secure adequate drainage. These are being given uniform fall to a point of safe discharge. This point of safe discharge is, where possible, provided by offtake ditches along intersecting road allowances, or in many cases by constructing ditches across adjoining private property. The width of grade on top is increased on our roads where heavy traffic demands it, such as in the vicinity of larger cities and towns. Also across standing water our standard width is increased to 22 ft. on top, and the side slopes protected by riprap or seeding down to grass. Although Saskatchewan generally lives up to its reputation of being level prairie country, still the road-builder finds that it is scarred across with deep coulees and low hills, requiring considerable care in the location of our roads to secure satisfactory grades. The maximum grade is fixed at 7 per cent, and we are usually able to keep this down to not exceed 5 or 6 per cent.

To construct our earth roads at an average cost of $2,500 per mile we have of necessity to build our roads out of material over which the road passes, or, at all events, within short team haul of the road. We have, of course, found that prairie soil differs very much in its value as a road surfacing material, and a great deal can be accomplished by using good judgment in the selection of the material conveniently available. Thus, in crossing slough bottoms, alkali flats, etc., earth which can be obtained from side casting is frequently not suitable for surfacing material, in which case while we may put in the bottom from the material taken from the side of the road, we usually endeavor to surface the grade with a foot of better material hauled in. Gravel or gravelly soil can often be obtained from the banks of sloughs or by cutting down hills adjacent thereto, which provides an excellent road surface. One of our most difficult problems is building our roads in sandy stretches of country, especially where, as sometimes happens, the sand is of such a light powdery nature that it blows with the wind into sand dunes. These sandy stretches are surfaced with gravel or by covering with clay, where this can be obtained, and mixing it with the sand for a sand-clay road.

With very few exceptions, work on our provincial highways has been carried on by contract after calling for tenders duly advertised, as provided for in the Canada Highways Act.

Costs.—I give below a statement showing the different classifications for work called for in our tenders, and the average cost of each for the years 1924 and 1925. The main item, earth excavation, you will note, had dropped from 23 ct. a cubic yard in 1924 to 20 ct. in 1925. I am of the opinion that competition in 1925 had forced the unit price for earth excavation down to 20 ct. a yard, and there was very little profit in it for contractors at this price. At all events, although I have not the figures complete for 1926 work, I anticipate that the price will be a little higher than last year. The average cost of construction of the 2,000 miles completed to date will work out at $2,500 per mile. This is the total cost, including engineering, advertising, culverts and bridges, not exceeding 20-ft. span, the actual cost varying from $1,500 per mile on comparatively level prairie or where the road had already been partially constructed, to $5,500 per mile on roads requiring heavy construction or clay or gravel surfacing. The average cost of gravel surfacing, 1,100 cu. yd. per mile, is $1,516 per mile; or sand-clay surfacing, with 2,900 cu. yd., $3,220 per mile.

Classification—Unit:	Average Cost 1924	1925
Earth excavation—cubic yard	0.231	0.202
Loose rock excavation—cubic yard	0.742	0.667
Solid rock excavation—cubic yard	1.950	1.692
Overhaul—cubic yard 100 ft.	0.040	0.040
Riprap—cubic yard	1.790	1.848
Gravel surfacing—cubic yard	1.025	0.871
Clay surfacing—cubic yard	0.588	0.558
Guard rail—lineal feet	0.303	0.341
Clearing—acre	24.710	20.869
Grubbing—10,000 sq. ft.	17.070	14.793

The Development of a Highway System

Experiences in Wisconsin Outlined in Paper Presented Sept. 29 at 13th Annual Meeting of Canadian Good Roads Association

By J. P. DONAGHEY
State Highway Engineer of Wisconsin

In Canada you are confronted with the same difficutlies that we in the United States have been confronted with, especially in selecting routes for through highways connecting larger centers of population. The early roads were laid out on the section lines, without regard to topography or direction between important centers.

You will find in a few years, as your country becomes more highly developed in an agricultural way, that it will be difficult to get away from the old section line locations.

Laying Out Through Highways.— You must remember that the distance on two sides of a section is two miles and that diagonally through the section is approximately 1.4 miles. The saving in distance is 0.6 of a mile and if you are paving with 20 ft. concrete, it means about $18,500 in money. Distance cannot be disregarded when laying out a real system of through highways, as great savings, not alone in construction cost but in future operating costs, can be made by constructing along the most direct routes.

The average cost of operating a motor vehicle cannot be estimated at less than 10 ct. a mile. Therefore, if a saving of five miles between two important centers of population can be made by following a diagonal line rather than by following the section lines, it will result in a saving of 50 ct. for each motor vehicle trip over that road. Assuming that it is an important highway and that you have an average tra¼c of 500 vehicles per day the shorter route would result in a saving to the vehicle owners of $250.00 per day, or approximately $93,000.00 annually. Capitalized at 6 per cent this would justify an expenditure of $1,500,000 to secure the short route.

You can readily see that it is good public policy in laying out a highway system in a comparatively level country and a country that is in the process of developing to plan for direct routes between larger centers of population as much as possible, and still fit into local conditions. This policy, of course, is not so necessary on secondary roads, but can well be considered, even on strictly local roads.

Factors to Be Considered in Location.—The location of a road should be finally settled before the first dollar is expended for permanent construction, if possible, and in selecting a location, distance is not the only factor to be considered. The character of the soil, drainage conditions, local materials available, also the snow drifting problem should be well considered, as all of these matters really affect the proper location of a highway. The width of right-of-way is also very important, and if the road you are locating is destined to be a heavy traffic route between large centers of population, be sure to secure a right-of-way of a sufficient width for the future. Rights-of-way on important through highways should not be less than 100 ft. in width and many times a greater width should be secured.

A larger blade grader pulled by a powerful tractor will move earth in a comparatively level country cheaper than any other equipment. We are grading many miles of highways in this way at a cost not to exceed $500 per mile, and in many instances much less, providing a good, wide, safe roadway with reasonably good drainage. This last, of course, does not include the necessary bridges and culverts; but on roads of this class we invariably use metal culverts, which are easily installed and will last twenty years or more. The width from shoulder to shoulder should not be less than 24 ft., and, on important highways we are now using 30 ft. as the mimimum.

On secondary roads a minimum width of 20 to 24 ft. is often sufficient for the present, but we have found that the cost of grading in a level country, where the above equipment is used, is but little more to provide an ample width than a width that will soon be inadequate. Most of the present day graders are equipped with bank slopers that finish a road in a very neat and attractive manner, and I am sure these refinements are well worth what they cost.

Flat Sections Highly Desirable.— We have found that a flat section is highly desirable, even on an earth road, especially where patrol maintenance is employed. It is easier to maintain a road surface, either earth or gravel, where the crown does not exceed 4 in. in 24 ft. width than where it is greater. Where a flat cross section is maintained, traffic is not confined to one track but is well distributed over

the entire surface. Where excessive crowns are maintained, traffic will try to hold to the peak of the crown, especially in rainy weather.

We find it is much more expensive to maintain a road surface where traffic all follows the same track than where it is well distributed. This is one of the hardest problems we had to solve in handling our patrol maintained roads in Wisconsin.

A road must be smooth for motor traffic, and if it is smooth a slight crown will shed water. If ruts are allowed to remain they will hold water regardless of the crown. The local people invariably insisted upon a high crown for the earth and gravel roads, and it took several years to convince them that the flat section was much more desirable and much more economical to maintain than the other.

If the road follows a rolling or hilly country, then the equipment should include two or three good sized fresnoes operated either by a small caterpillar tractor or three horses. The fresnoes are used to move the surplus material longitudinally from the high points to the low points as the grader piles the excess material up along the shoulder of the road. By this means a road can be completed as the grading operations proceed and a very smooth and well compacted surface will result. If the road carries 50 vehicles or more daily it should have a light gravel surface if gravel is obtainable at anything like a reasonable cost. We have found that gravel crushed or screened to a size that will pass a 1-inch opening and containing all the fine materials gives the best service. It can be worked back and forth very easily with a blade grader and results in a smoother and more satisfactory road than if coarser or even finer material is used.

Sand-Clay Construction.—If gravel is not available, and sharp sand can be obtained within a reasonable distance, it is frequently advisable to cover the surface with a few inches of good sharp sand. Mix the sand with a few inches of the clay surface by plowing, using a disk harrow or any other method that will thoroughly mix the sand and clay. If a road of this character is gone over frequently with a light grader, moving the surplus material back and forth until it is well compacted, watched carefully and sand added where needed, a very satisfactory surface can be maintained for light traffic. Where sand soil prevails an application of clay on sand will give very satisfactory results if thoroughly mixed and compacted.

Crushed Stone Surface.—Where no gravel deposits are available and limestone, trap rock or granites are to be found within a reasonable distance of the road, very satisfactory results can be obtained by crushing the stone to a size that will pass a 1-in. round opening, applying the crushed material, including all of the finer materials, to the earth surface and working it back and forth with a blade grader just the same as gravel. Practically the same results will be obtained. In fact, we believe a better surface is obtained with fine crushed stone than with gravel. In cases where we use the fine crushed stone, as described, it is compacted by traffic without the use of a roller, just the same as gravel. The advantage of using crushed stone in this manner is that a surface can be built up from year to year. We limit our first application to a maximum of 3 in. loose depth. When traffic has compacted this thoroughly, the weak places are strengthened with additional material and new material should be added from time to time to take care of the wear which occurs with traffic. Material is stock piled along the road side for this purpose. We have been able to build up a very satisfactory road in this manner in about three years' time with little, if any, interference with traffic, and we believe when the road is finally completed we have a better road with less material and at a lower cost than if built to our standard section immediately.

This plan also makes it possible to get traffic through a road with a small expenditure of money, adding to this from year to year as necessity requires.

I believe I can safely say that our gravel roads in Wisconsin have given entire satisfaction. It has been through the use of gravel that sentiment has been developed for more and higher type surfaces. When a community has used a gravel road for several years they will not, under any consideration, accept a lower type road. Sentiment will gradually develop for a higher type surface, and even though a gravel road wears out under traffic and becomes inadequate, no one can say that the people's money has been wasted in providing the gravel surface. The people will readily see that the gravel surface has saved them many dollars in transportation cost during its life, and when traffic has reached a point where the gravel surface connot continue to handle the traffic, and a higher type must be provided, they are willing to provide the money to build it. There is an old saying that "a child must creep before it walks," and this applies equally well to highway improvement. It is almost impossible to convince the average community that it is more economical for them to build and pay for a concrete road in the very beginning than to build and wear out one or two gravel roads and finally come to the high type surface.

We have found it useless to try and educate the public from the top down, that is, sell them the "last word" in highways to begin with. It must be worked from the other angle. They must first be shown conclusively that

they cannot afford to pay the transportation costs incident to operating their vehicles over an unsurfaced road. When this thought has become thoroughly impressed, then, and then only, can they be sold the idea of building a higher type road.

Care of Gravel Road.—A good gravel surface will handle traffic very adequately up to an average of 50 to 800 vehicles per day without anything but good patrol maintenance, and the addition of new material as it wears away. When traffic gets beyond 800 vehicles per day, a dust layer of some kind should be used. Calcium chloride is used by us to very good advantage; it does lay the dust and assists in compacting the surface of a gravel road. In other words, it is a dry weather proposition, draws the moisture from the air, thereby laying the dust, and the moisture assists in compacting the surface. When we have reached a traffic of 1000 vehicles or more on a gravel surface, some other method must be provided, due to the fact that traffic as heavy as 1000 vehicles will displace a large amount of material annually, unless the surface is bonded with bitumen. We have many hundreds of miles of gravel surfaces carrying heavy traffic which would not last one season if the surface were not bonded properly. About ¾ gal. per square yard of bitumen is used, which bonds the surface of the gravel in a manner that produces a safe and pleasant surface and prevents the grinding up and blowing away of a large amount of material annually. Saving in material alone, we are satisfied, repays the cost of the bituminous surface treatment, which will average from $800 to $1,000 per mile per year.

In order to provide a wide selection of resurfacing materials for gravel and old concrete roads we are opening up our specifications to include bituminous compounds, without void fillers, similar to amiesite. We find that bituminous surfaces in our climate will stay in place better and are less inclined to slip or buckle where the aggregate used contains no material below ¼ in. in size.

Gravel Road Maintenance.—The average cost of maintaining our plain gravel roads for ordinary traffic is about $250.00 per mile per year. Up to the last two years the maintenance has been performed by what we call team patrols. A patrolman is selected for each 6 or 7 mile patrol section, provided with a light blade grader and other necessary small tools. He receives about $150 per month for a period of eight months, which results in a cost per mile of approximately $200 for his services. There is delivered to him for his use approximately $50 worth of new material per mile annually, which he desposits in the weak places, thereby keeping the surface in the proper shape.

As traffic increases, heavier equipment is necessary for the proper results, and this is provided through the motor grader. The last two seasons we have been rapidly changing from the team patrol to motor patrol. In most cases, motor-driven graders have been replacing the team graders with very satisfactory results. A motor-driven grader on a light traffic road will easily take care of twenty miles. As the traffic increases the section naturally must be shortened; but the fact that the motor grader does much better work is very evident. It operates much faster and more continuously than the team grader. We have not been able to reduce expenditures; but the work is much superior. If the team patrol was compelled to do equal work, the cost would be much greater.

I believe that you in Western Canada can safely follow the policy we have followed in Wisconsin, which has been to do one of two things—either build a cheap road giving immediate service to a community with the idea of eventually building a high type surface when traffic demands it and financial conditions will warrant; or, if you know that traffic conditions are such today that a gravel road cannot stand up, then build the best high type surface. We in Wisconsin believe this to be portland cement concrete. We never have any apologies to offer in building either of these two types of road, which is not the case often times when other types are constructed. No one expects the impossible from a cheap gravel road, but when roads cost from $30,000 to $50,000 per mile they do expect that they will give service without a heavy annual maintenance cost. We are fortunately situated in Wisconsin, having material suitable for concrete aggregates well distributed over the entire state. This makes it almost compulsory for us to build concrete pavements rather than other high type surfacings, because we build it cheaper. Our average cost for concrete paving in 1925 was $1.88 per square yard. This is based on a section 9 in. in thickness at the edges and 6½ in. in the center. I believe this to be a lower price than any state in the Union can boast.

Cost of Motor Vehicle Operation.—Again, I wish to call your attention to the necessity for providing an all-weather surface at least on your main traveled highways. We now have in Wisconsin 650,000 motor vehicles. We have made an effort to determine the annual cost of owning and operating a motor vehicle. From information furnished us by manufacturers, distributors and users of motor vehicles, we find that the average cost of owning and operating a motor vehicle in our state is approximately $350 annually. This includes interest on the investment, depreciation, operation and general up-keep of the car. There-

fore, it costs the people in Wisconsin $228,000,000 annually, to own and operate the 650,000 motor vehicles. This is more than all the taxes we pay in Wisconsin, including the federal tax, state tax, county tax, local tax, including schools, by $100,000,000. If the people of our state are going to continue to own and operate this number of motor vehicles, which I am sure they will, and incur the tremendous incidental expense they certainly must be willing to spend a reasonable sum annually to provide a track upon which to operate these vehicles. The cost is much greater if the roads are bad than if they are good. Our license fees which now average $14 per car and our 2 ct. a gallon gas tax, provide an annual revenue of approximately $14,000,000 for highway purposes. Should this $14,000,000 expenditure be withdrawn for one year, the cost of operating the 650,000 motor vehicles would jump $50,000,000 at least, between three and four times the amount of motor vehicle license fees and gas tax paid by the owners.

I think you can readily see that the motor vehicle owner should pay more, rather than less, towards building and maintaining the highways which he uses, and that has been our policy in Wisconsin. We find few in opposition to this policy and we do find many who are advocating an increase in motor vehicle revenues rather than a decrease.

I am trying to bring out the point that you must pay a highway tax whether you have good roads or poor roads. If you have good roads in your community you are paying a good road tax in the form of license fees, gas tax or direct tax, and if you have not good roads in your community, you are paying a road tax, but it is a bad road tax, in the form of broken springs, excess gasoline and upkeep of your motor vehicles, smaller loads and more trips for your horse-drawn vehicles, resulting in a much higher transportation cost when everything is figured than if good roads are provided. We pay the tax, whether the roads are good or bad, and the tax is greater if the roads are bad.

Step Rate Policy of Highway Development.—Nothing will develop agricultural, nothing will develop your cities and villages, or your citizenship more than the building of good highways. Get the idea out of your head that building a road cheaply is a waste of money, for it is not. No road honestly built in any community has been a waste of public funds. I have been in this game a long time, nineteen years to be exact; I have lived to see in Wisconsin the fourth type of road built on the same location. Each of the three earlier roads built has returned value received to the community much in excess of its cost. In no case was it money thrown away. It served the purpose of that day and was all that could be provided under the circumstances. This same road has finally reached the stage where it is built of 20-ft concrete. I hope to live long enough and think I shall to see this road built again.

We believe in a step rate policy of highway construction as far as possible. I know that you cannot grade a road to the width that is necessary 25 years from now, but if it is properly located, practically all work done on that road will be a distinct advantage in the future. Use the earth road just as long as it is economy to use it; then surface it with gravel and use that until the traffic drives you to something better; build a better road of the width you can finance at that time; use that until traffic forces you to build a wider high type road, and when that time comes you will find a way to finance it.

Soil Experts and Highway Engineers

Knowledge of the properties, constituents, and behavior of different types of soil has not only an agricultural bearing but is of great importance to the highway engineer. Hence is often becomes necessary for the specialists of the Bureau of Soils of the United States Department of Agriculture to co-operate with those of the Bureau of Public Roads in investigations in localities having peculiar soil conditions to throw light on problems in highway engineering.

It has been shown, for instance, that the clay soils in the eastern part of Texas and in the Piedmont region possess the properties indicated by a low ratio of silica to iron plus alumina, and are probably the best to meet the requirements of good highway subgrade material. In southeastern Ohio, again, it was found that hillside slipping of masses of soil and subsoil material in the extensive area of Upshur soils of that region had completely demolished sections of recently laid concrete roads. Similar destructive sliding connected with this type of soil has occurred in southwestern Pennsylvania and in many parts of West Virginia. The problem seems to be one that will require serious attention from highway engineers. Another example of the co-operation between soil and road experts is the Black Waxy Belt of Texas, where, in the opinion of the soil expert, the black clay of the region is not the best material upon which to lay hard surfacing. It tends to swell and shrink according to extremes of moisture. Other available road material is advised for use in the subgrade.

Municipal Asphalt Plant in Street Maintenance

Methods and Costs of Repairing and Resurfacing Pavements at Brantford, Ont., Given in Paper Presented Before Canadian Good Roads Association

By F. P. ADAMS
City Engineer, Brantford, Ont.

The average Canadian city with a population of from 15,000 to 30,000 usually has its main business and residential streets paved with some form of so-called permanent pavement. In the older provinces this may run from a few blocks of brick to concrete, to bitulithic, tar macadam, and sheet asphalt, and probably a few other varieties. They present a problem to the engineer charged with their maintenance, which must be met in an adequate way and with equipment and material suitable for the purpose. The unpaved streets of the city also, which a few years ago were sadly neglected, now call for attention.

It is the purpose of this paper to show that a municipality owned asphalt plant can be used to do this work economically and well, and can be used not only for keeping in repair and resurfacing the pavements but for maintaining the gravelled streets in a condition to meet the demands of modern traffic.

Repairing Oiled Streets.—In Brantford we have, roughly speaking, 16 miles of paved streets and 65 miles of unpaved. Of the latter 40 miles are treated each spring with a coating of 40 per cent asphaltic road oil. The oil is used because not only does it act as a dust layer, but what is just as important, in the course of a couple of years an impervious water-tight surface is formed which carries the roadway through the fall and spring rains without rutting and its consequent destruction.

The ordinary method of maintaing such a surface is to keep a certain amount of loose material moving by means of the road grader into the holes as they form, but this method is not practicable in the city due to the obstructions of manhole covers and crossings. We make up at the plant a lean mixture of asphalt and pit-run gravel which has been run through the crusher, and fill up the pot holes as they form. This material contains about 65 per cent stone, 35 per cent sand, with 4 per cent asphalt added. It is brought on the street hot in drays and shovelled by hand where needed, raked out and rolled with a 5-ton roller.

This year a total of 943 tons of the mixture was used, costing as follows:

Material including gravel and asphalt	$1,106.26
Fuel oil and coal	480.02
Sundries	6.39
Labor	2,203.47
Use of plant and repairs to plant, $1.50 per ton	1,414.50
Tools, 5 per cent; engineering, 5 per cent	370.50
Total	$5,581.14

The average cost of the material was $5.92 per ton in place on the street. The work was done in 17 days, which makes an average of about three miles of street repaired per day, with a daily output of 55 tons from the plant.

The mixture used for this work is the same as we use for the base course in black base pavements. It wears with the rest of the road surface, and when after several years service the road is scarified and remade it breaks up readily under the scarifier and roller and is incorporated with the rest of the surface material.

Some form of bituminous material is absolutely necessary for this purpose on oiled streets and we find that the work is done quickly and efficiently by using the plant for this purpose.

Patching and Resurfacing Bitulithic Pavements.—We have about three miles of bitulithic pavement laid on a concrete base. It was laid during 1908, 1909 and 1910. These streets have stood up well under traffic but are wearing thin in spots and during the past few years have required an increasing amount of repairs to keep them in condition.

Last year it was decided to resurface several of these pavements. Most of the surface material was still sound and good for many years of service. The method adopted for the resurfacing, therefore, was to spread over the bitulithic a coating of sheet asphalt mixture the thickness of which varied according to the needs of the case. By taking precautions to see that the old surface was thoroughly clean and dry before applying the sheet asphalt and using an asphaltic cement to bind the two materials together a pavement was secured which will last for many years, and at about

half the cost of an entirely new surface. The detailed figures of cost are given below for a total yardage of 25.242 sq. yd.:

	Cost per sq. yd. ct.
Labor	20.1
Materials	22.0
Charge for use of plant and repairs to plant	15.0
Tools and machinery	2.0
Engineering	2.0
Interest	0.5
Total cost	61.6

We have laid this type of resurfacing since 1921 and it is proving very satisfactory under moderately heavy traffic.

New Asphalt Pavements.—For new work a municipally owned asphalt plant will save many dollars. Our experience has been that costs run from $2.25 to $2.50 per square yard for black base pavements consisting of 4½ in. of asphaltic concrete base and 1½ in. of sheet asphalt top. These figures include excavating and an adequate charge for use of plant. There has not been much difference between the cost of pavements with asphaltic concrete bases as described above, and 6-in. portland cement concrete bases with 1½-in. binder and 1½-in. sheet asphaltic top, the figures being slightly in favor of the black base pavements. Two typical asphalt pavements laid in 1923 cost as follows:

Church St.; 1,842 sq. yd.; 4½-in. asphalt base, 1½-in. asphalt top.

	Cost per sq. yd.
Excavation	$0.31
6-in. asphalt pavement	1.69
	$2.00
Machinery and tools	.10
Asphalt plant	.35
Total cost	$2.45

Clarence St. from Chatham St. to Elgin St.; 6,330 sq. yd.; 6-in. concrete base, 1½-in. asphalt binder, 1½-in. asphalt top.

	Cost per sq. yd.
Excavation	$0.44
6-in. base	.93
3-in. top	.82
	$2.19
Machinery and tools	.11
Asphalt plant	.25
Total cost	$2.55

The writer has also used the plant to resurface old worn-out brick pavements in need of repairs. In fact, any good sound base the surface of which has worn out can be resurfaced with asphalt at a very moderate cost, and the miscellaneous collections of various types of pavement with which most of our cities abound can in time be made over with a uniformly good type of construction.

Cost of Plant.—The cost of a plant may seem somewhat high to a small municipality, but I have endeavored to show that it will turn out material suitable for the repair and maintenance of all kinds of streets and after all, a municipality should not hesitate to invest money in equipment if it can be shown that such an investment is sound.

Our plant cost $25,000 in 1921. Since that time $15,619 has been written off this capital charge after allowing for repairs to plant and interest on the investment. This amount has been secured by making a plant charge of 35 ct. per square yard on black base pavement, 25 ct. per square yard on 3-in. asphalt surfaced pavements, 15 ct. per square yard on skin patched work, and $1.50 per ton on the mixture used for repairs to gravelled streets. The plant is in first class condition today and good for many years of service. Repairs to streets have been made when needed and years added to the lifetime of many pavements at a very moderate cost.

I consider that a close inspection of the materials turned out is essential to the success of asphalt pavements. The usual screen tests on the sand and temperature tests are made and a sample of the mix is sent each day to a competent chemist for analysis and report.

Nothing adds to the prosperous appearance of a community like well kept streets and these can be secured only by the use of equipment capable of meeting all conditions. It has been my experience that a municipally owned asphalt plant with its complement of road rollers and scarifiers will place in the hands of the engineer the means of maintaining the streets under his charge in the condition demanded by the travelling public.

Delivering Concrete at 20 Miles Per Hour

To expedite the work and cheapen the cost, Gutleben Brothers, contractors for the State on the Rio Hondo Bridge on Whittier boulevard, Los Angeles County, Calif., have constructed a novel motorized outfit for delivering concrete mix. The arrangement is described in California Highways as follows:

A second-hand Ford automobile with the wheels and body removed was fitted with flanged wheels for operation on an industrial railroad. A riveted sheet steel hopper takes the place of the body for carrying the concrete. The mixer dumps directly into the hopper and the driver steps on the throttle and the load is quickly delivered to its destination on the bridge.

A lever near the driver's seat makes it possible to release the mix on either side of the hopper as desired. The speed at which a load of fresh concrete may be delivered makes the apparatus very effective, in the opinion of the contractors.

Roman Roads in Britain

Some Interesting Notes on Their Location and Construction from The Engineer

The extraordinary significance attached by the Romans to their roads is well illustrated in the fact that only the most eminent men were counted worthy of being responsible for their maintenance. Plutarch records that the great Julius Caesar "was made overseer of the work for the highway called Appius Way," and adds that Caesar spent largely of his own money on works connected with this road. Following him and under the Empire, Augustus himself had charge of all matters pertaining to the roads.

As is well known, the Roman roads in the province of Britain were Imperial roads in exactly the same sense as were the Appian Way from Rome to Brundusium (Brindisi) and the Domitian Way from Sinuessa to Pozzuoli. From the date given in the Itinerary of Antonine ("Itinerarium Antonini Augusti"), it is estimated that the total length of the roads in the Roman Empire was approximately 52,964 Roman miles, the Roman mile being about eleven-twelfths of the English statute mile.

That section of the Itinerary which relates to Imperial roads in Britain contains, as is well known, fifteen "Itinera." The wording of the Itinerary suggests that the British roads were of the class designated "Iter," an order of road intended for pedestrians and horsemen, but the many examinations made in recent times even on roads—such as the "Fosse"—which did not connect with one or other of the legionary fortresses, show that substantial carriage traffic passed over them. The ruts made by wheels, for example, have been disclosed in many places, and their centers measured.

The date of the construction of the most important of the Roman roads in Britain cannot be placed later than the third quarter of the first century A. D., and in all probability was considerably earlier. That their antiquity—as Roman roads—is of this order, finds confirmation in the fact that the Emperor Claudius was here in 44 A. D., with four legions and their corresponding auxiliaries, a total force approximating, it is estimated, 40,000 men.

Every legionary was not only what we should call a heavy infantryman, but he was a sapper besides, and the work of laying out the permanent roads in Britain would proceed simultaneously with the penetration of the country. Moreover, the rapidity and skill with which the Romans constructed fortifications is proverbial, and equally conspicuous is the fact that they usually worked to definite specifications.

Construction Features.—The construction of the roads did not differ in any important respect from the standard construction adopted in and about the Imperial City itself, though the bulk of the materials employed were, of course, those afforded by the districts traversed. While the Appian Way was paved for 120 miles with polygons of lava, the roads in Britain were surfaced, for the most part, either with stone or with selected flints.

As regards foundations, it was the practice of the Roman builders to consolidate the road bed by ramming, and thereafter to build up the mass of the road by superimposed courses. The first of these courses, the "statumen" or foundation, was commonly composed of flat stones laid in mortar. Over the "statumen" was a well-rammed course of rubble (the "rudus"), topped with the so-called "nucleus," which consisted of gravel in the proportion of about three parts of gravel to one part of hot lime. The surface—frequently referred to as "summam crustam" or "pavimentum"—was usually of stone paving, well bedded into the nucleus.

These road structures were made to a thickness of about 3 ft., and the Roman roads in Britain were usually built to a similar specification, though variations following upon the character of the country traversed are common, and certain of the road structures appear to have resembled the "Vias Terrenas" or unpaved roads, such as were built, from time to time, in other parts of the Roman Empire.

There was never constructed in Britain anything resembling the magnificent streets—"Via Militaris"—which existed in the city of Rome, streets built over the immense sewers which are mentioned by Pliny and ranked by him among the greatest works ever undertaken. Pliny records that so minute was the supervision of these structures that citizens desiring to transport abnormal weights along roads supported by the vaulting over the sewers were obliged to undertake responsibility for any damage which the inspectors of sewers deemed as having ensued from such transportation.

Location of Roads.—Regarding the methods of surveying, no observer can view the existing Roman roads in this country without admiring the technical ability of those military engineers of antiquity. The popular view that straightness is their chief characteristic does not give sufficient credit to the skill of the men who planned them, since remarkable judgment was shown in so positioning the roads as to afford not only the most direct route, but the one which gave the maximum advantage so far as relates to observation. The fact that the Roman surveyors preferred high ground when an easier alternative might have

been chosen arose usually from military considerations.

Straightness is, of course, a very conspicuous feature of these roads, as may be seen from the fact—pointed out by Codrington—that the so-called "Fosse" Road, which, commencing at Lincoln, seems to have penetrated to Devonshire, does not deviate by more than 6 miles from a straight line, approximately 182 miles long, joining the extreme points. South of High Cross, in Leicestershire, there is a stretch of Watling St. which, on a distance of 28 miles along Iter 11 of the Itinerary, does not deviate by more than three-quarter-mile from a straight line.

Pavement Superheater

A machine designed for heating, by means of a hot air blast, old or worn concrete, granite blocks, brick pavements, wood blocks, macadam roadways, or any other hard surface, for the purpose of bonding thereto a layer of asphaltic wearing surface, is illustrated. The same principle also can be applied to new Portland cement concrete foundations in order that the top or wearing surface may be vulcanized to the Portland cement concrete foundation, to prevent slipping or shoving.

The machine is mounted on a framework carried by a tractor and is moved from place to place, starting, stopping and braking exactly as any tractor. The heating arrangement consists essentially of a blower, oil burner, sectional steel furnace, flue and hood. The furnace is of all metal construction. It consists of an inner, or combustion tube, enclosed in an outer tube. The inner, or combustion tube is made in sections, in order to facilitate replacements and to reduce the cost of repairs. The burner end is closed by a hinged door which can be opened for inspection of the combustion chamber. The air enters between the inner and outer tubes, at the end farthest from the burner, and passes between the two tubes until it reaches the burner end of the combustion chamber; thence through the combustion chamber and an elbow which turns the blast toward the road, and into the hood. The hood is 8 ft. x 8 ft., or 64 sq. ft. of heating surface. It is counter-balanced by springs and is raised and lowered by a hand-wheel. The over-all length of the outfit is 27 ft., and its weight is under 8 tons.

The machine was designed and constructed under the direction of G. H. Lutz. It is made by the Good Roads Equipment Corporation, City Centre Building, Philadelphia.

Preventing Fires on Wooden Deck Bridges

In a discussion before the Boston Society of Civil Engineers, Lewis E. Moore, Consulting Engineer, Boston, gave the following useful suggestions:

"Another source of trouble on wooden decks is fires. This danger can often be obviated by very simple means. One bridge in Massachusetts suffered greatly from this cause. The deck was wooden and there were heavy wooden curbs on each side of the roadway. Dirt and slivers of wood would collect against these curbs and a cigarette butt would do the rest. The wind blows very hard at this location most of the time, so the writer suggested about ten years ago that the curbs be raised on wooden blocks so that the wind blowing under them would keep the bridge free from dirt and debris. This was done and there has not been a fire on this bridge since."

Junior D Model "Greco" Pavement Superheater

Highway Bridge Maintenance

Methods of Michigan State Highway Department Described in Michigan Roads and Pavements

By L. N. JONES
Assistant Bridge Engineer, Michigan State Highway Department

The maintenance of bridges on trunk line and federal aid roads is one of the important functions of the state highway department. A considerable amount of work and expense is required annually to keep these structures in a safe and suitable condition for traffic. Of the 600 bridges on trunk line and federal aid roads in the state which are maintained by the state highway department approximately 300 are steel structures which require painting at frequent intervals for their preservation. About 150 of the trunk line bridges have either timber, wood block or bituminous floor surfaces which require frequent replacement or repair. Miscellaneous repairs and alterations on the older structures are necessary from time to time.

Maintenance Crews and Equipment.— The bridge maintenance work is done by crews working directly under the Highway Department, each crew being in charge of a foreman, and the work of all crews being supervised by a bridge maintenance superintendent. Each crew is equipped with a truck and the necessary small tools, tackle, scaffolds, etc., to take care of the ordinary repair work. Special truck units are provided for the transportation of paint spray equipment, cement gun, air compressor and other heavy equipment. During the present season four maintenance crews have been employed, this number being lower than in the average season. Throughout the summer months the majority of the crews are engaged in painting steel structures in order to take advantage of the favorable weather. During other seasons their time is spent on making floor repairs, substructure repairs and other miscellaneous work. The number of crews and the number of men employed is usually reduced during the winter months when certain classes of work cannot be economically conducted.

Painting Steel Structures.—The painting of steel structures is essential in order to preserve the steel and insure its safe condition throughout the life of the structure. Under ordinary conditions one coat of paint every five years is required in order to properly protect the steel from corrosion. On all new work a red lead paint is used for the shop coat and for the first field coat and a white lead paint tinted to a gray color is applied for final field coat. In maintenance painting, the choice of the paint to be used depends upon the condition of the old paint. If the outer coat is merely discolored or slightly powdered but the under coat is still in good condition the surface is brushed and one coat of gray paint is applied. If there is any extensive failure of the priming coat, the steel is thoroughly cleaned and given a coat of red lead to be followed by the final coat of gray. In many instances the failure of the priming coat is only local in which case the points of failure are cleaned and "spotted" with red lead preliminary to the application of a complete coat. It is essential that all rust and scale be removed from the steel before the application of any paint. Its removal is accomplished by chiselling, scraping and brushing. When the structure has become badly rusted, the proper cleaning of the steel and its preparation to receive the paint often involves more labor than the application of the paint.

The paint is generally applied by means of brushes. On relatively large flat surfaces such as plate girders and floor beams or in places which are inaccessible to the brush the paint is applied by means of an air spray. The application by the spray is followed by a thorough brushing in order to produce a uniform thickness of paint film and to prevent wrinkles or sags. In all cases the paint is worked out under the brush until the film is as thin as is consistent with the necessary covering of the under coat. Successive coats of paint are applied at intervals of not less than 30 days and the minimum interval is made three months whenever practicable so as to insure the thorough hardening of the first coat.

Repairing Bridge Floor Surfaces.—The repair of floor surfaces is another important item of bridge maintenance work. For old steel structures which will not carry a concrete floor the department has adopted as a standard a double timber floor consisting of 3-in. transverse plank covered by 2-in. longitudinal plank. Nailing strips of hard wood are bolted to the tops of the stringers and the transverse plank are securely spiked to these strips. The life of the ordinary yellow pine longitudinal plank under heavy traffic is about four years. The transverse plank, if given a brush coat of creosote, will usually last twice as long as the longitudinal plank. Wood block floors, of which there are only a few remaining on trunk line bridges, require a seal coat of bituminous material at least once each year in order to prevent the absorption of moisture

by the blocks with consequent expansion and buckling. Asphalt and macadam wearing surfaces require seal coats at intervals of from one to three years with patching when necessary. Whenever possible old concrete floors which have become worn and rough are used as a base for a new concrete wearing surface. Aside from those cases where there is serious disintegration, concrete floor surfaces require practically no maintenance.

Repairing Concrete Work.—On many of the older structures, where a poor quality of concrete was cast or where the footings were placed at too high an elevation, the substructure is found to disintegrate at or below the water level or the footings are under-scoured by the current. The repairing of such failures ordinarily involves the driving of timber sheeting along the face of the footing or abutment and the filling of the space between the sheeting and the concrete with new concrete. If the underscour is not serious rip rap may be deposited along the front of the footing to prevent further scouring action.

The disintegration of concrete above the water surface is usually repaired by means of the cement gun. All loose and disintegrated concrete is removed and the resulting opening filled with the cement gun mortar applied under a high pressure. The cement gun has also been used with success in repairing masonry abutments in which the mortar used for pointing has fallen out. The careful use of the cement gun insures a permanent and sightly repair.

Other miscellaneous items of maintenance work include repairs to superstructures, both steel and concrete, repairing of backwalls, hubguards and railings, cleaning of shoes, removal of obstructions from stream channels and the construction of ice breakers and fender piling. Each of these cases is a problem in itself and the method of repair must be suited to the particular conditions encountered.

Motor Bus Systems Oppose U. S. Control

Proposed legislation which would put motor truck and bus systems under federal control was protested by operators who appeared before the session of the interstate commerce commission on Oct. 26.

Legislation providing federal regulation through state agencies was suggested by T. H. MacDonald, chief of the bureau of public roads. Only a slight degree of regulation for motor trucks was advisable, Mr. MacDonald said. He stated that the bulk of passenger and freight movement was between points within states. C. A. Rietz, secretary of the Truck Owners' Association of Maryland, and other witnesses, opposed the proposed regulations.

Second Annual Southwest Road Show and School

The second Annual Southwest Road Show and School will be held in Wichita, Kans., February 22-23-24-25, 1927, under the auspices of the Wichita Thresher & Tractor Club, Inc. This show and school covers more than nine states and will be staged in Wichita's $2,000,000 exposition building, which covers almost a block, has more than three acres of space available for exhibiting purpose, and was the scene of the very highly successful initial road show and school.

The Good Road School will be under the direct supervision of the Kansas State Highway Commission, K. S. A. C. with the cooperation of the Southwest States, federal and state highway engineers, and other organizations in the Southwest that are interested in the school and good roads.

More than 30,000 sq. ft. of floor space has been allotted to the Southwest States for good road school exhibits, the U. S. Bureau of Public Roads and other exhibits that will be brought to Wichita for the benefit of the good road school.

An elaborate program is being arranged for the good road school which will be announced later, to which everybody will be invited and admitted free. It will be arranged so that it will be exceptionally interesting and educational for state, county, township, municipal and road officials, contractors, material producers, and to anyone interested in the construction of good roads, maintenances, and construction work.

The officers and directors of the organization promoting this show and school consist of:

A. D. George, President; C. V. Newman, Vice-President; F. G. Wieland, Secretary-Treasurer, General Manager; A. A. Ward, H. P. Peterson, H. W. Cardwell, W. J. Easton, C. W. Ferree, G. F. Ahlberg, H. A. Smythe and E. L. Kirkpatrick.

General headquarters have been established by the organization of 1927 Road Show and School at the corner of William and Water Streets, Arcadia office of the Exposition Building, under the direct supervision of F. G. Wieland, Manager.

New $15,000,000 Highway in England.—According to a London press dispatch a great new highway to connect Liverpool with the main portion of industrial Yorkshire is to be constructed at a cost of some $15,000,000. The government is to provide 75 per cent of the cost, the remainder being provided by Liverpool and the county authorities of Lancashire and Yorkshire.

Deterioration of Structures in Sea Water

Abstract of Institute of Civil Engineers Report in Engineering, London

The investigation of the deterioration of structures in sea water is not a problem as secular in character as those of agriculture, but it is eminently one which has to be studied over prolonged periods before any results can be expected. This is the reasonable explanation of the considerable number of interim reports which the Committee of the Institution of Civil Engineers have produced on the deterioration of timber, metal and concrete in sea water, since 1916, with the assistance of grants from the Department of Scientific and Industrial Research, the sixth of which has just been published. It will be remembered that the scheme of experiments included biological as well as chemical observations, and, except for an important summary of work done by the American National Research Council, the present deals with further work on the lines to which considerable reference has been made in previous reports.

The biological results obtained in the present year's observations confirm the view that the protection of timbers from marine parasites is differential, and highly satisfactory results may be obtained as against one parasite by the use of a substance that may be indifferent to another, though another substance that has had considerable effect on the latter may be relatively inoffensive to the former. This matter is for the time being in the hands of the chemists.

Against the *teredo* larvæ a definite order of concentration is found to lie between some couple of dozen substances which have been tried. The substances so far proved to be most effective are mixtures of creosote in some arsenic compounds, and extended trials are being made on a special method of impregnation. Prepared samples have been despatched after treatment for exposure in various waters. On the other hand, *limnoria* is not specially susceptible to any of these substances, except an expensive organic compound, and the whole problem of providing a cheap specific against this organism is still open. It is to be observed, however, that in a few experiments in Leith Docks by Mr. A. H. Roberts, the use of good creosote served to keep redwood "practically immune" from *limnoria* for two years, though similar timber not so treated was, like oak, pitchpine, and American elm, attacked up to ¼-in. thickness, except in the resinous bands. Greenheart, on the other hand, was found "perfectly immune" for a similar period.

An important set of experiments has been projected by Professor S. M. Dixon for carrying out tests with arsenic compounds on a larger scale. In these tests the timbers (4 in. by 4 in. by 4 ft.) were exhausted to a 10-in. vacuum, and after the vacuum had been held for 30 minutes, the creosote was admitted. The temperature was then raised to 48° C. and the pressure to 190 lb. per square inch, both temperature and pressure being kept constant for an hour. The vacuum was dropped to 15 in. for a further 30 min., after the creosote had been run off. In addition to the arsenic compound in creosote, three concentrations of carbazole are also being tried, and some sticks have been merely painted with a stronger concentration of the arsenic compound in creosote. An interesting feature of this test is the wide variation shown in the density of the specimens and the increase in weight on creosoting. The timber was Archangel pine, straight grained and free from large knots, and was commercially dry at the time of creosoting (average 12 per cent moisture). The actual variation in density of untreated timber ranged from 40 lb. per cubic foot to 27 lb. per cubic foot, though the average for nine sets of sticks varied only by some 10 per cent. The total number of sticks was 252, and for any group of 28 sticks the increase of weight from creosoting varied between 33 per cent and 45 per cent, with an average of 38 per cent; but the extreme range varied from 11 per cent to as much as 100 per cent.

The considerable series of paints on steel, under investigation by Mr. F. E. Wentworth-Shields and Dr. J. N. Friend, and of special steels at stations abroad, are under continued trial, and seem likely to have positive results. But until the specimens are finally taken up nothing definite can be said. Trials are also projected of a variety of chromates.

Other intermediate results are reported, and their significance will become apparent as the observations proceed. In a sense perhaps the most interesting section of the report is contained in an abstract contributed by officers of the Committee on Marine Piling Investigations of the Division of Engineering and Industrial Research of the National Research Council of the United States. This report summarizes the very large amount of work which has been done in the United States on this subject, stimulated as it has been from time to time by vigorous attacks of parasites in their various home waters. How extensive this has been—though what is here presented is only a relatively short summary—may be judged from the fact that a classified biblio-

graphy occupies sixty pages of text. The selection of the subject matter for the abstract, not always an easy task, appears to have been admirably done. This excellent résumé might well have been extended. How many civil engineers could state offhand the average weight of wood excavated daily by a shipworm, need not perhaps be estimated. It is sufficient to say that, as the mean of many observations, it is no less than a centigram per individual, or about five times as much as has hitherto been believed.

Average Life of Automobiles

The results of a study to determine the normal life history of automobiles are given in a bulletin issued recently by the Bureau of Business Research of the University of Michigan. The study was conducted by C. E. Griffin, Professor of Marketing at the University. The method employed was to take a sample of cars of the 1923 registration and, by comparing it with a sample of the 1924 registration, determine the "death rate" for cars of various ages in the intervening period. The study was made on automobiles in the state of Michigan. It happened that in 1923 and 1924 the registration authorities of Michigan obtained from automobile registrants the year-model of the car registered as well as other data; and they have published in some 35 volumes (1924) the license number, name and address of owner, make of car, and year of manufacture. Employing this source of information a sample of 41,641 cars was taken from the 1923 reports and 49,245 from the 1924 reports. The total number of cars each year-model in the two registration periods, as indicated by the samples, were then compared.

The following conclusions are given by Prof. Griffin in the bulletin:

(1) The mortality rate for automobiles follows a curve similar in form to that for human lives and for various types of industrial goods.

(2) The average life of motor vehicles generally is 7.04 years.

(3) The average life of Ford cars is substantially longer than the average life of all other cars as a group.

(4) The average life of automobiles has shown a definite though not a steady increase.

(5) The rate at which automobiles of a given year's production are eliminated from use is indicated by the following facts: of any given 100,000 cars placed in use, 75 per cent will still be in use at the end of 4.75 years, 50 per cent at the end of 6.94 years, and 25 per cent at the end of 9.2 years.

(6) The normal "expectation of life" for cars of different ages is as follows: for new cars it is 7.04 years; for cars 3.5 years of age, 4.27 years; for cars 6.5 years of age, 2.8 years; for cars 9.5 years of age, 1.8 years; and for cars 12.5 years of age, 1.2 years.

(7) On December 31, 1924, 93.1 per cent of the cars produced in the preceding 5 years, 76.9 per cent of those produced in the preceding 10 years, and 71.3 per cent of those produced in the preceding 15 years were still in use.

(8) The average age of the cars in use on December 31, 1924, was 3.07 years.

(9) The replacement demand has shown a marked increase both absolutely and relative to the total demand. This tendency will continue. It is predicted that the replacement demand of 1926 will be 1,796,000 cars, of 1927, 2,063,000 cars, and of 1928, 2,341,000 cars. This increase in replacement demand means that the automobile market is approaching a stabilized condition.

(10) At a rate of production of 4,000,000 cars a year, and exports of 5 per cent of production (approximately the present rates), there would be in the United States in 1930 a total of 28,580,000 cars, or one car for every 4.3 persons of the estimated population for that year.

Salvaging Surface Material Removed During Oiling

Prior to making applications of asphaltic oil on sections of the Redwood highway, Division I, of the California State Highway Department, all loose surfacing material is broomed off to permit the oil to penetrate downward into the road surface. The loose material often contains considerable valuable rock. According to California Highways, to salvage this successfully, Division Engineer T. A. Bedford devised a screen built on wheels so that it may readily be moved from place to place. It is 6 ft. long and the wheels have a 4-ft. tread. Mr. Bedford reports that two men can recover 16 yds. of rock per day at a cost of 50 to 75 cts. per yard, depending upon the nature of the material.

When using a Number 10 screen 20 to 40 per cent of dust is found in the roadside sweepings.

Where it was desirable to recover portions of the rock mulch surfacing for covering the road after the applications of oil, the division devised an efficient method of removing the rock from the dust. A wire screen of ¼-in. mesh was substituted for a portion of the blade of a Rogers scoop shovel. After a few preliminary shakes of the shovel roadside rock, free of dust, can be handled upon the road.

The Maintenance of Gravel Roads

Methods of Minnesota State Highway Department Described in Paper Presented Sept. 28 at 13th Annual Convention of Canadian Good Roads Association

By W. E. ROSENWALD

Maintenance Engineer, State Highway Department of Minnesota

The maintenance of gravel roads is a problem that varies with the volume of traffic carried, the nature of that traffic, the physical character of the material out of which the road is made, and the climatic conditions prevailing. The order of importance of these factors is as here given.

The Organization Important.—In order to cope with this problem satisfactorily, on a system of major roads, or any other roads for that matter, and with the least waste of effort, it is necessary first to have an organization equipped therefor. In this organization it is essential that it be under control of men trained as engineers with ability to analyze conditions. Second, that this control be free from political influence. Third, that each road be divided into suitable sections, with a competent man, as maintainer or patrolman, continuously working and in direct charge and responsible therefore at all times. Fourth, that there be an unbroken line of responsibility and control from the maintainer to the head of the organization. With these essentials taken care of, it is reasonably certain that but little money will be wasted or needlessly expended, and in case of stringency of funds, more can undoubtedly be accomplished for the money available, than if handled under a less practical system.

Minnesota's Gravel Roads.—Gravel roads in Minnesota are built from natural gravel deposits found all over the state. These deposits vary widely in texture and quality of material, but they are used as found, except that all rock over one inch in size is removed by screening, and in rare cases some of the fine material is also removed. This gravel is placed on road grades varying widely in nature of material, from sand, through variety of soil mixtures of sand and clay, to clear clay. Also traffic conditions vary widely, from 200 light motor vehicles per day in some sections to several thousand vehicles per day in other sections, many vehicles being extremely heavy trucks.

It can be seen that with this multiplicity of conditions it is almost impossible to formulate any fixed set of regulations for carrying out maintenance work. If Minnesota has achieved any degree of success in its gravel road system of several thousand miles, this success has been due to the ingenuity and ability of the men in responsible charge of the many subdivisions of this organization.

In our maintenance organization, those in responsible charge are without exception men with many years of engineering training and experience. There is no political interference and no change of personnel except through natural causes. The whole organization is free to concentrate its attention on the problems at hand and the new ones constantly arising. It is seldom that a solution is found wanting or that an emergency cannot be met.

The Field Organization.—The field organization in Minnesota, which would probably fit any extensive road system, is as follows:

The trunk system is divided into maintenance districts of approximately 450 miles, with an engineer superintendent in charge of each district. The district is equipped and manned to operate independently as much as possible. There is a district office, a district shop, and all necessary road equipment provided for each district.

The districts are subdivided into maintenance sections with a patrolman in charge of each section. The length of the patrolman's section depends principally on the nature of his equipment, which in turn is largely influenced by the volume and nature of the traffic, as well as the physical character of the road.

The Patrol Systems.—Our patrolmen on gravel roads may be generally divided into three classes, as follows:

Team patrols consist of a man, team, patrol blade machine, wagon and the necessary small tools. The average length of team patrol sections is six miles. As the traffic becomes heavy enough the team patrol is supplemented by a power unit, either tractor or truck, which usually supplements the work of a number of team patrols. It is also often advisable to stockpile gravel by truck at frequent points,

handy for the patrolman, in order to avoil long, uneconomical team hauls.

Tractor patrols consist of a man and a small tractor attached to a blade machine. The average length of tractor patrol sections is 15 miles. It is, of course, necessary to supplement the tractor with a team or truck to do the necessary hauling of patching or surfacing material. Sometimes a small gang is used for this purpose.

Truck patrols consist usually of two men, a truck of not over two tons capacity, with dump body, and either a blade scraper under the truck or a blade machine towed behind. The average truck patrol section is 19 miles in length.

While the volume of traffic is light, say up to 300 vehicles per day, it is comparatively easy to keep the roadway smooth and a team patrol can spend about one-half of its time hauling gravel and still do the necessary blading or planing to keep the road smooth.

Except on extremely light traffic roads the patrolman will hardly hold his own, in replacing worn-out gravel, and it will be necessary to go in with extra forces and assist in hauling gravel (anywhere from 400 to 800 cu. yd. per mile) at intervals of from two to five years.

Control of Corrugations.—As the traffic increases, proportionately more gravel is required to replace that worn out, and at the same time surface corrugations begin to be troublesome, with the consequence that heavier machinery is necessary to do the smoothing. This is where the supplemental units are resorted to, or it may be necessary to change the type of patrol. Scarifying is of great help and we use scarifiers rather freely, particularly just before adding any considerable amount of gravel.

Corrugations or wash-boarding and the dust nuisance usually become serious at about the same time. The corrugations can be held in control fairly well by heavy blading and by careful selection and screening of the gravel placed on the road. Avoiding coarse gravel makes possible a better blading operation and we are at the present time screening out everything over 1 in. in size. All our gravel used for surfacing is screened.

Dust Prevention.—The dust nuisance is another matter and can only be controlled by some kind of surface treatment. Where the road surface is of a fine sandy and dusty nature, treatments of calcium chloride will be successful in keeping down the dust, but do not particularly reduce the need for heavy smoothing operations. Where the traffic approaches the 1,000 vehicles per day mark, it becomes economical to use bituminous treatments, particularly if the possibility of paving is still quite a number of years in the future. Bituminous treatment, of course, also eliminates the dust, but changes the nature of the smoothing operation and radically changes the renewing and patching operations, tools for special gangs, which are usually temporarily employed.

The two-horse graders are of the 8-ft. blade type, weighing about 1,200 lb. Wagons and small tools are of the usual type. For heavy supplemental work the state furnishes caterpillar tractors, heavy blade graders, trucks, elevating graders, dump wagons, motor patrols of various types and makes, and in fact all kinds of road machinery as needed and required.

Contract Work.—Contract work is done whenever the performance can be clearly specified, such as in gravel hauling, grading, and oil application. Day labor is used on general and routing performance which cannot be covered definitely by units for payment.

Smoothing Operations.—Smoothing the gravel is carried on whenever the road surface needs it. Dry weather attention is often as important as wet weather attention. Heavy motor patrols weighing five tons or more are necessary when traffic reaches over 500 vehicles per day. In some cases occasional attention is sufficient while in others almost daily attention is needed. It is possible to do too much blading with heavy machines, which hastens the accumulation of loose material in dry weather. Smoothing operations should hold the crown of the road to about ⅛ ft. for a 24-ft. roadway. The low crown invites traffic to use all of the roadway and saves the surface from the side thrust of cars caused by high crowns.

Bituminous Surface Treatments.—Road oil and tar of various grades are being used to bind gravel surfaces where traffic is heavy. Incidentally this also eliminates the dust. Such treatments are successful in proportion to the subsequent attention given them along maintenance lines. One of the heaviest travelled roads in Minnesota, so treated and carefully maintained, is serving traffic excellently.

For dust laying, calcium chloride spread at the rate of about 10 tons per mile in two applications gives very good service. The treatment must be repeated annually and is applied at such times that the heavy summer traffic is benefitted.

Snow Removal.—During the coming winter an attempt will be made for the first time to keep all the trunk highways open all winter. Many miles of road are naturally protected by timbered country and dense growths of cornfield. Three hundred miles of snow fence will be erected at strategic points, all road patrolmen will be employed throughout the winter, and numerous snow plows will be kept in readiness all over the state to open up any heavy accumulation of snow.

Concrete Pavement Bids in Tennessee

Unit low Prices on State Roads Analyzed in Tennessee Highways

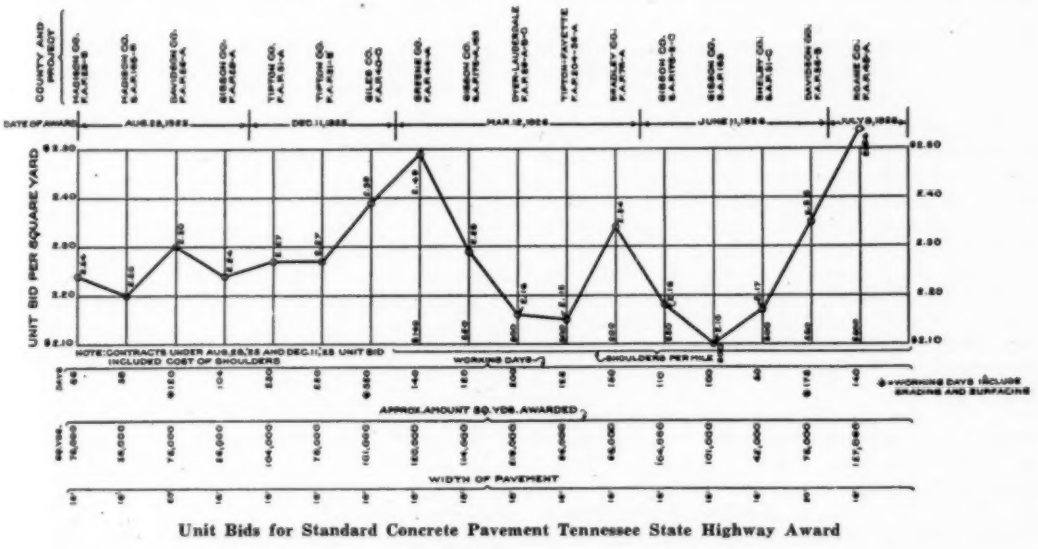
By O. H. HAMPSCH
Chief Draftsman, Tennessee State Highway Department

An analysis of the unit low bid prices for cement concrete pavements awarded since July, 1925, in Tennessee State road work, shows a cost per square yard varying from $2.10 to $2.54. The variation of the unit cost per square yard is due to accessibility of road material, as sand, stone or gravel, the transportation facilities and shipping points, water supply for curing, etc. Where the alignment requires curves to be widened and banked, the operation of paving is naturally slowed down due to additional form work and labor required for finishing the pavement. This causes variations in unit bid prices between East and West Tennessee.

The standard design used is an 8 in.—6 in.—8 in. slab with a center longtitudinal construction joint. In March, 1926, the specifications were changed to include a ¾ in. transverse expansion joint, either poured or premoulded at 35-foot intervals, the cost of the joints included in the unit price per square yard for cement concrete pavement. Under these new specifications a unit price for shoulders (per mile) was also added, all previous contracts for shouldering having been included in the unit price per square yard for the paving.

The state uses ordinarily an 18-ft. width of paving except the trunk roads nearer the larger cities where 20-ft to 24-ft widths are used. The mix is composed of 1 part Portland Cement and 5½ of fine and coarse aggregate, making the aggregate proportioned approximately 2 parts sand to 3½ stone (or gravel). All curves of 1° or over are superelevated beginning at a minimum of ¼ in. per foot to a maximum of 1 in. per foot for those of 11° or over. Superelevation begins and ends 100 ft. from the point of curvature. Widening is required on all curves above 8° from 2½ ft. to 6 feet, depending upon the degree of curvature used.

Contracts for paving are ordinarily awarded separately after the grading work has been completed and fills compacted. The state awarded approximately 140 miles of concrete paving during the past 12 months.



Unit Bids for Standard Concrete Pavement Tennessee State Highway Award

In considering the awards of the contracts the time limit expressed in working days is computed against low bid on the basis of the following:

Amount of Original Proposal	Amount of Liquidated Damages Per Day
$ 10,000 (or less)	$10.00
10,000— 20,000	20.00
20,000— 50,000	30.00
50,000—100,000	40.00
100,000—200,000	50.00
200,000—400,000	65.00
400,000 (or more)	80.00

A working day is considered as any day, except Sundays and legal holidays, when the condition of the weather and soil that it is possible for a period of six hours or more to proceed with the project.

State Highway Expenditures in 1925

Nearly $650,000,000 Spent Last Year by State Highway Departments

The total expenditure by the state highway departments in 1925 for road and bridge construction on the several state highway systems amounted to $649,125,101, according to reports from the highway departments just compiled by the Bureau of Public Roads, United States Department of Agriculture. Of the total expediture 59.6 per cent was spent for road and bridge construction, 18.4 per cent for maintenance and 3.5 per cent for materials and equipment. Administrative and engineering costs accounted for 4.7 per cent of the total, interest and principle payments on bonds 7.8 per cent, and miscellaneous expenditures amounted to 6.0 per cent of the total.

To meet these expenses the highway departments received from various sources during the year a total income of $780,081,292, of which $115,656,721 was available as a balance from the previous year's operations, so that the amount of money raised during the year was only $664,424,571. Of the latter amount 43.5 per cent was raised by means of motor vehicle license fees and gasoline taxes, 30 per cent from the former and the balance from the latter. The sale of bonds realized 21.3 per cent of the total for the year, and Federal aid received from the National Government amounted to 13.9 per cent. Funds transferred to the state by the counties and other local governments amounted to 10.8 per cent, and the balance was made up of funds derived from special highway taxes and appropriations and from miscellaneous sources as follows: Taxes, 3.3 per cent; appropriations, 5.0 per cent and miscellaneous 2.2 per cent.

Although the year's expenditures were slightly greater than the previous year's total of $605,665,207, the balance of $130,956,191 carried over into the current year was even greater than the amount of unexpended funds carried over from 1924. The rate of construction remained about the same as in previous years.

One of the most significant facts brought out by the report is the remarkable increase in the percentage of the total highway income derived from motor vehicle and gasoline taxes, and the falling off in the percentage representing real and personal property taxation. There has been a steady tendency in this direction since 1921. In that year the combined income from motor vehicle licenses and gasoline taxes amounted to 25.9 per cent, the gas tax revenue amounting to less than one per cent. In 1925 the income produced from these sources was 43.5 per cent of the year's total and the gas taxes alone amounted to 13.5 per cent.

In the same period taxes on property specifically for road purposes have dropped from 11.2 per cent to 3.3 per cent of the year's total income. Including the income from appropriations and miscellaneous sources, most of which is raised indirectly by property taxation, the 1921 percentage was 20.7 and the 1925 percentage was 10.5.

Funds raised by the sale of bonds were also a smaller percentage of the total in 1925 than in 1921, being 21.3 per cent in 1925 as compared with 27.8 in 1921.

The expenditures by the various state highway departments during the year are given in the table below. These figures do not include expenditures by county and local authorities for local roads.

Alabama	$ 10,917,204	New Hampshire	$ 4,027,241
Arizona	2,442,947	New Jersey	23,939,454
Arkansas	11,200,000	New Mexico	3,322,548
California	18,090,728	New York	49,368,770
Colorado	5,564,590	North Carolina	32,588,514
Connecticut	8,611,936	North Dakota	1,862,348
Delaware	3,492,841	Ohio	24,086,289
Florida	8,483,752	Oklahoma	12,937,673
Georgia	7,902,428	Oregon	15,553,453
Idaho	3,636,681	Pennsylvania	62,294,336
Illinois	36,375,983	Rhode Island	3,045,859
Indiana	14,517,794	South Carolina	9,132,953
Iowa	14,107,798	South Dakota	6,378,176
Kansas	7,407,369	Tennessee	14,379,189
Kentucky	14,916,316	Texas	19,985,007
Louisiana	8,610,624	Utah	4,123,798
Maine	7,105,389	Vermont	3,618,327
Maryland	12,024,781	Virginia	14,071,555
Massachusetts	12,880,700	Washington	7,845,566
Michigan	36,138,549	West Virginia	16,138,729
Minnesota	17,962,567	Wisconsin	7,784,733
Mississippi	4,795,192	Wyoming	3,973,494
Missouri	31,593,937		
Montana	1,267,242	Total	$649,125,101
Nebraska	5,563,752		
Nevada	3,055,959		

Oiling Sand Shoulders

Sand shoulders, particularly those adjacent to river crossings, have caused considerable trouble on the Valley route in Division VI of the California state highway system. An oil treatment has been tried adjacent to the Merced River which promises satisfactory results.

Previously, ½ gal. per square yard of 45 per cent oil was harrowed into the sand about 4 in. deep and 6 ft. wide. This, however, did not bind satisfactorily, especially in the light blow sand. Recently, ½ gal per square yard of 65 per cent oil was worked in and indications are that the trouble at this particular point is over.

Contract Working Time

How Working Time in Field Is Charged by Pennsylvania State Highway Department

Time is an essential element of a contract and in order that there be true competitive bidding, the time allowed must be stated in the proposal and understood by all.

The charging of contract time must be considered impartially, as the interests of the public and the contractor both are involved. The policy of the Pennsylvania Department of Highways and the method of charging working time in the field is outlined as follows in a circular issued last month by W. H. Connell, engineering executive and acting secretary of Highways:

The department's Form No. 476 is used for indicating the basis upon which the department has determined the contract working time. This analysis of time and allotment to the various major operations will be considered satisfactory unless the contractor chooses to use a different plan and schedule. If he chooses to do this he shall discuss the matter with the district engineer and obtain his approval and a new Form 476 shall be worked up and used as the basis of operation in checking the contract working time.

Legal time is the correct working time after the legal starting date and is used for determining liquidated damages. The actual time includes any time used previous to the legal starting date plus the legal time and is used for determining the actual progress and cost of the various items.

The district office, upon receipt of a notice of execution of a contract, will notify the contractor to begin operations on a stated date providing he has not done so in the meantime. This date usually is ten days from the date of the letter to the contractor and the charging of working time begins at the time stated in the notice. If the contractor has begun operations, working time is charged from the date of notice-to-proceed given to the contractor.

As the remission of working days or extension of contract time is vested entirely in the secretary of highways or his deputy, the inspector is instructed to charge time for every day or fraction of a day with the exception of legal holidays or Sundays, when the weather will permit work on the major controlling operations and he has no alternative. He is instructed to keep an accurate record for all delays and their causes, these being submitted to the district engineer for his consideration.

Controlling Major Operation.—The Controlling major operation may be defined as that operation which controls the progress of the contract at any time. Generally speaking, grading will be considered the major controlling operation until such time as the schedule provides for the starting of the base course or surfacing. If the contractor continues to grade after paving is scheduled to start and weather conditions would not permit paving, no time shall be charged, based upon the consideration that the surfacing operation will require the scheduled amount of time for its completion and is the major controlling operation at that time, regardless of the grading. Very frequently the contractor desires to continue grading operations during the winter months while the grading operation is still the controlling major operation. In this case, time will be charged proportionate to the work accomplished to that scheduled, until such time as the grading operations cease to be the controlling major operation, and from that time on no charge will be made for grading.

In order that the contractor may be fully informed of the time charged on any particular project, the district engineer is instructed to notify him monthly of such charges and request an immediate discussion of any exceptions the contractor desires to take. If the district engineer concurs with the contractor, he will advise him that he will recommend such remissions to the secretary of highways for his consideration.

Causes for Remission of Working Time.—The principal causes for recommending remission of working time are equipment breakdowns, embargoes or failure to obtain delivery of material, delays due to public service companies' failure to remove or relay structures within the limits of the work, and increasing items in the contract. No remissions will be considered for causes other than those over which the contractor has no control, or for which he is not responsible. The contractor is considered responsible for supplying labor and materials and only in extremely exceptional cases, where it is shown that the contractor has used every practical means to meet this requirement and has failed through no fault of his own, will remissions be considered.

Adjustments of contract time for increased or decreased quantities will be made at the rate of progress indicated in the schedule, or at a satisfactorily lower rate of progress according to the conditions, which will be determined by the engineer.

Failure to anticipate conditions and to complete minor operations which delay any controlling major operations will be considered the contractor's responsibility.

The district engineer's recommendations will be considered by the secretary of highways each month, providing the remission recom-

mended amounts to at least 10 per cent of the original time allowed in the contract.

When operations are discontinued during the winter months, the district engineer is instructed to notify the contractor in the spring that operations must be begun on a given date and time will be charged from that date and carried along in the same manner as on a contract just executed, providing however, the contractor has not begun a controlling operation before the given date, when in such cases time shall be charged from the beginning of such operation. Reasonable time for closing down work in the fall and resuming in the spring will be allowed without charging time.

Liquidated Damages.—Liquidated damages are provided in the contract and are assessed for two reasons: First, the expense and inconvenience to the public for the failure of the contractor to complete the work for the use of the traveling public; and, second, the expense of administration for overhead and inspection during the extra time used by the contractor.

The district engineer may recommend that after the pavement is opened for traffic and after the contract time has all been used, all time charged thereafter may be remitted with the exception of the equivalent of the inspectional charges. If such recommendations are approved the charge shall be the actual inspectional charges during such period, based on calendar days regardless of working days that were consumed.

If any special cases arise that are not covered by the above conditions the district engineer is instructed to submit the facts to the main office for decision.

New 1¼-Yd. Gasoline or Electric Shovel

A 1¼-yd. gasoline or electric shovel has been added to the line of excavating machinery of the Osgood Co., Marion, O. In addition to shovel work, this machine is designed for efficient service as a crane, with hook block or clamshell bucket, and as a dragline excavator, without necessitating any changes or additions to the operating machinery, the only change being the booms and buckets.

The machine is built up almost entirely of open hearth and alloy steel castings and little cast iron or structural steel enters into its construction.

Only four friction clutches are used in the usual operation of the machine. These are of the outside contracting band type and are easily adjusted and renewed.

Gearing is by plain spur gears, the number being reduced to a minimum by careful design. All upper body gears have teeth machine-cut from the solid.

The Osgood 1¼-yd. gas or electric shovel is mounted as standard on an enclosed gear drive continuous tread truck of simple and rugged design. The chief features of construction are the all gear drive with enclosed gears running in heavy oil; large supporting area of tread belts, steering from the upper body, in any position, with ability to turn gradually or on machine's own center axis; and an underside clearance of 12 in.

The shovel crowding is accomplished by a very simple wire rope mechanism which is self adjusting to all boom angles and involves no chains or other complications.

Among other features of this machine are the manganese front dipper; combination oak and steel boom and handle; "Special Osgood" 6-cylinder gasoline engine with accessories, including self starter as standard; two-finger

Osgood 1¼-Yd. Gas or Electric Shovel

control of the drum clutches through the "Osgood Servo" mechanism; an all steel house with enclosed front and the combination gasoline tank and counterweight.

The combination gasoline tank and counterweight is made of cast iron, the center being made hollow. It is built into the upper body and becomes an integral part of the machine adding strength and solidity to the deck structure. This casting is made in one piece with very thick walls which insures freedom from leakage caused by buckling or rusting and also from the possibility of catching fire. The capacity of tank is 75 gal.

Mississippi Valley State Highway Departments to Meet.—The 19th annual conference of the Mississippi Valley Association of State Highway Departments will be held Jan. 13, 14 and 15th at the Hotel Sherman, Chicago, Ill. G. F. Schlesinger, Director of Highways and Public Works of Ohio, is president, and T. J. Donaghey, State Highway Engineer of Wisconsin, is secretary.

An Improved Type of Jeffrey Portable Conveyor

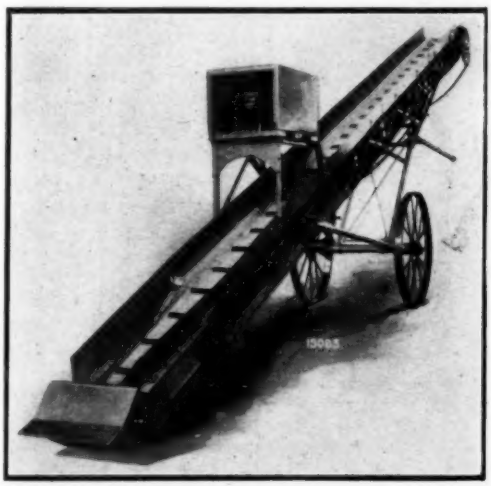
The Jeffrey Manufacturing Co., of Columbus, O., has recently put on the market an improved type of portable belt conveyor for handling sand, gravel, crushed stone, bricks, tile, boxes, coal, coke, and similar materials.

The new features consist of four important developments:

Steel side boards which are bent to extend under the side of the belt forming with belt a moving trough which provides larger capacity and prevents lumps from rolling off.

An improved type of carrying idler to support the loaded portion of the belt.

An extended and flared loading leg at the bottom, edged with belting material to form a



New Jeffrey Portable Conveyor

seal with the moving belt. The flared hopper also centers the load on the conveyor.

An efficient gate at the foot of the conveyor to prevent material from falling into the enclosed boot housing.

In addition to these recent improvements attention is directed to several other important features of the Jeffrey design, as follows:

Built in 18, 24 and 30 ft. lengths, and is furnished with electric motor or gasoline engine.

A reliable and easily operated screw adjusts the elevator to any convenient height. Different holes in the pipe struts allow wheels to be adjusted forward or backward to balance the load.

Foot of conveyor is low so that it will readily enter a pile of loose material. Foot pulley has efficient aligning screws to bring belt in center.

Belt furnished in 16 in. rubber covered, troughed. A one-piece cast iron idler. Return idlers form an efficient belt cleaning device.

Loading leg bunches up material in center of belt and avoids side spill.

Steel flights attached to center of belt to increase carrying capacity on machine, keep small round particles from rolling down the belt, and are so arranged that they cannot catch on material and tear the belt.

Measurement of Workability of Concrete

From October Technical News Bulletin of U. S. Bureau of Standards.

A study of the workability of concrete mixtures is being carried out at the U. S. Bureau of Standards under a co-operative research arrangement with the Celite Products Co., Los Angeles, Cal. The purpose of this work is to devise an apparatus which will measure accurately that quality of concrete known as workability and to obtain this measurement in units which are used in engineering work.

Several years ago a penetration apparatus was developed in the cement section of the bureau for the measurement of workability. The apparatus consisted of a 6x12-in. cylindrical mold mounted upon a small table which can be raised or dropped about 1/10 in. by means of a cam. A spider carrying a sleeve is mounted on the top of the mold. Through the sleeve a close-fitting rod is introduced in alignment with the axis of the mold.

The batch of concrete to be tested is placed uniformly in the mold and first compacted by 30 drops of the table, then the rod is inserted in the sleeve and lowered gently into the concrete until it comes to rest under its own weight. The cam shaft is then turned and the mold full of concrete is successively raised and dropped in such a manner as to allow a reading of the penetration of the rod after each impact. The test was regarded as completed when the rod had penetrated the concrete 10 in.

As the same means were used for driving the rod through the mass as were used for compacting it, the test was not reliable for the lean and harsh working mixtures. To overcome this objection and to secure more exact measurements on all mixtures a new method has been devised for driving the rod. The new part of the apparatus is similar to a pile driver in that a weight is released from a fixed height above the rod and falling free drives the rod through the concrete without

further raising and lowering of the table, once the concrete is uniformly compacted. The workability is measured by the reciprocal of the work in causing the penetration of the rod.

Tests have been made on concretes of different proportions from 1:1½:3 to 1:3:6 in which the amount of water was varied to give consistencies from a very dry mix to a wet mix. The data so far obtained showed the difference in consistency quite markedly. First the dry mix requires the most work, then by adding more water the concrete becomes more workable, until a point is reached where too much water has been added, causing segregation, and the workability is again decreased. In order to confirm this preliminary study further tests are being carried out and additional studies are being made in which a body of compacted concrete is deformed instead of a displacement of a part of the mass, as is done in the penetration apparatus.

After a method of measuring workability is full developed, it is planned to test a wide range of concrete mixtures in which other qualities will be determined, and the relation between them and workability will be studied.

Alley Grading with Truck Loaders

Frenzel Bros., Chicago, Ill., specializing in alley grading in Chicago, have concentrated on truck loaders for this work. They have developed a very efficient technique of operation, in which the element of time is of the greatest importance, as the concrete paving contractor is right on their heels all the time.

The average alley is about 400 ft. long and the excavation runs about 1 cu. yd. per foot. First a 5-ton tractor with a railroad plow loosens the ground, usually plowing an alley in three hours. Then a gang of 10 or 12 shovelers goes in and finishes the sides to grade and puts the spoil within the 8-ft. swath handled by the loader. Three hours is enough for them. The loader then starts at one end, loading trucks that back in on the finished grade under the discharge spout. Eight hours is the usual time per alley for the loader. It takes about five trucks to the loader, depending on the length of haul. Five-ton trucks carrying 8 yd. of loose dirt make up most of their fleet. Frenzel Bros. are using five Haiss loaders in their alley grading operations.

Alley Grading Operations with Haiss Truck Loader

Earth Road Construction

Equipment and Working Combinations Used in Alberta Described in Paper Presented Before Canadian Good Roads Association

By N. H. BRADLEY
District Engineer Public Works Department of Alberta

In presenting this paper I have decided to describe only the principal types of machinery used in Alberta, together with some working combinations. In doing this, one must not forget to mention the humbler tools, such as shovels, picks, grub-hoes, axes, sledges, saws, etc.

Road Plow Primary Tool.—Generally speaking, the road plow is the next primary tool on road construction. A good average road plow, for prairie work, should be light, but very strong and designed to give the plowman as full and easy control as possible. This means correct position, length and height of handles, as well as a properly designed beam and mould board. Plow shares and share shapening is a science by itself. It has often been found that the pointing of a share has a lot to do with the successful operation of a plow. For example a drawn out and slightly depressed chisel point works well in dry gumbo.

Scraper and Crowder.—To move the earth, loosened by the plow, the simplest tools are the slip or drag scraper, and the wooden "V" crowder. The latter is usually made up on the job where it is to be used, and consists of two 3-in. by 12-in. by 16-ft. or 18-ft. planks braced apart in the form of a "V", with or without steel shoes made from grader blades or fresno bits. This tool is used for crowding out the first few furrows plowed on steep sidehill work, before a grader can be used.

The slip has to a large extent been superceded, on prairie work at least, by the buck or fresno scraper, a tool with considerable merit. I believe that fully half the dirt moved on road construction in Alberta is handled by this tool, hauled by four horses. One might ask why the fresno has superceded the slip scraper. In answer it would have to be pointed out that the fresno moves more dirt, operates over a greater distance range and is easier for the operator to handle. Well designed fresnos have blades from $\frac{1}{8}$ to $\frac{3}{8}$ in. thick, well balanced hitches that make loading, hauling and dumping an easy operation, with the handle or Johnson bar at a man's hand at his hip, where he has great control, without stooping as low as with a slip scraper. Another advantage of the fresno is the adjustable height of the bit or blade when dumping, allowing a good dump man to spread dirt evenly, in thick or thin layers.

Wheeled scrapers are good tools for long hauls up to about 1,000 ft., especially when the crew is organized and trained for this work. Changing over a crew from using fresnos to wheeled scrapers causes such confusion and delay that rarely are wheelers used on rural work.

Blade Graders.—To an organized crew of from three to five fresnos and a plow, I would add one 7 or 8-ft. horse blade grader for spreading the dirt when making a fill across a short slough, and for smoothing up work every day during the making of a fill and occasionally thereafter. The road grader has developed from simple types that were used in a desultory way to special types suitable for various operations, and used for these and many others.

Of the construction-type blade graders, weighing from, say 1,500 to 9,300 lbs., there are a number of makes, each with their respective merits. A large mileage of suitable turnpiked earth roads are constructed by blade graders, of course bearing in mind that fills in low places are put in by fresno outfits. So far as Alberta is concerned, most graders with blades of 7 or 8 ft. are hauled by 8 or 12 head of horses, in teams of four; and some 8-ft. and nearly all 10 and 12-ft. blade graders are hauled by tractors. Some of the improvements of note attachable to these larger graders are ditch back-sloper blades, blade extensions for either end of the regular blade, and heavy lift springs to the blade and circle.

Working Outfits.—Let me describe briefly some working outfits on earth market road construction. One of the most flexible outfits consists of three fresnos and a plow, 16 head of horses, operated by a foreman and four men and an 8-ft. grader. This outfit will handle either filling or turnpiking on light work to advantage. One can add to this more men and teams with fresnos and a lighter grader, depending on the foreman.

Of straight grader outfits, with tractors supplying the power, here are examples:

One grader operator, one tractor operator, a handy man and a cook, make up the personnel. A 12-ft. blade grader, a 5-ton gas tractor, a Ford light delivery truck, and a combination cook and bunk car, make up the list of equipment. The handy man with the light delivery keeps the outfit in fuel and supplies.

Another outfit operating two graders, has a personnel consisting of two grader operators, an engine operator, two handy men and a cook. Two 12-ft. graders, a "Sixty" gas tractor, a 1-ton truck, and a combination cook and bunk car are the main units of the machinery.

One of the most complete outfits with which I am familiar has the following personnel: A foreman, two grader operators, two engine operators, a rock picker and a cook. The machinery and equipment consist of one forty-eight gas tractor, one fifteen-thirty gas tractor (old), one Fordson, two 12-ft. blade graders, a 1-ton truck, a combination cook and bunk car; water, distillate and grease wagons; a fresno, drag-harrow and plow. The head grader has a back-sloper attachment, which is used as required, the rear grader has extensions to the blade making it 18-ft. long, or sufficient to cover half of an 18-ft. road when working. The fifteen-thirty tractor was used for hauling the cook car, and distillate, water, oil and grease wagons, when the graders are working. The Fordson was used for harrowing weeds off the road and for smoothing up after the blades. It was also used for general work, keeping the outfit supplied, and for taking the dull grader blades to the shop.

Other Earth Road Equipment. — Elevating graders have been used to some extent but not to the same amount as on railroad work. Straight side casting or use with dump wagons has been limited, owing to the light and uneven nature of the work generally encountered. Steam or gas shovels, self-propelling, have been used on heavy work.

For maintenance of earth roads, the common road drag in its various forms, and the road plane or some blade grader, are indispensable. The maintenance of earth roads blends so nearly into their construction that the same machines are generally used. Scarifiers attached to blade graders or power units having this attachment are very desirable for reshaping and smoothing rough, wavy and wind-blown roads.

International Road Congress in United States in 1929

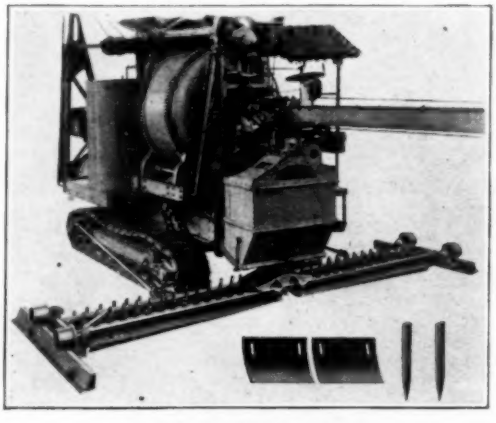
The International Road Congress will accept an invitation to meet in the United States in 1929, according to Senator Albert Mathieu, of France, president of the association. This assurance was given at the close of the congress held at Milan, Italy, Sept. 6 to 14, and in response to the statement by Thomas H. MacDonald, Chief of the United States Bureau of Public Roads and chairman of the official delegation from the United States, that the United States Congress would be urged to extend such an invitation.

The congress at Milan was attended by 2,000 delegates from 50 countries and 5 continents, and the United States was officially represented for the first time. Mr. MacDonald was made a member of the council of the congress.

Subgrade Planer

A subgrade planer developed during the past season in concrete paving work, is connected to the paver, moves along automatically, cutting down the high spots and filling in the low places. In this way, it is stated, the subgrade is finished to the correct level just before placing the concrete.

Wide wheels on each end of the planer, as shown in the illustration, ride on the road forms and support the frame. Scarifying teeth spaced about 12 in. apart are fastened



Koehring Subgrader Planer

to the frame ahead of the scraper blades so that the rough places are caught by the teeth and then brought down to smooth surface by the blades.

Adjustments can be made so that the planer will leave the subgrade with any crown desired. If no center joint is used, the blades are adjusted to close up the opening. In the average light soil of a subgrade, it is stated, the planer will grade efficiently to a depth of 2 in., but it is not designed to work in hard clay or in old macadam road bed, or one which has shale or rock embedded in large quantities. The subgrade planer was designed by the Koehring Co., Milwaukee, Wis.

Non-Skid Asphalt Surface.—With a view to lessening the danger of skidding by motor vehicles, asphalt coated screenings were used for finishing 2.8 miles of the widened and thickened trunk highway near Delano, Kern County, California. Thirty pounds of asphalt to a ton of screening was used. Screenings thus treated, it is believed, will stock and close the pavement, and at the same time leave the surface somewhat rough.

Cost Accounting

Suggestions from Address Before Southern California Chapter of Associated General Contractors of America

By DON G. HENDERSON
Secretary-Auditor, Scofield Engineer Construction Co.

Accounting, like contracting, has but recently attained the semi-security of being class as a profession. Its ranks have been recruited from two main sources—ambitious bookkeepers elevated by their own efforts, as are many contractors, with the usual faults of practical, selfmade men—and those trained almost exclusively in the offices of public accountants, with a vast fund of excellent theoretical ideas as difficult to assimilate to practical use as those of the college graduate before he has been mellowed by experience. There is this distinction—the public accountant seldom deserts his profession, and consequently remains theoretical to the end.

You who have been forced by circumstances to give consideration to cost accounting—really only a branch of general accounting practice—are thus obliged to import a system, or raise one by hand. Regardless of your choice, remember this:

Simplicity is of paramount importance. No system is stronger then its weakest link—and that link is usually some straw-boss on the job.

Flexibility is vital to normal expansion and contraction of your business. An inflexible system demands frequent changes, and nothing is so destructive of reliable cost data as changes in system.

Adaptability of other systems to your business is a prevailing vice—and never successful if carried beyond broad general principles. No "transplanted," "canned" or "cribbed" system is ever entirely satisfactory.

A Cost Accounting System Must Be Simple.—Limit the number of your accounts. Theorectically it is possible to keep costs on the smallest operation. Actually, an attempt to keep costs, continually, on a large number of accounts invariably leads to disaster. Skeletonize your list of accounts by main subdivisions only, then re-subdivide if you are interested in the cost of particular operations on certain jobs. This will correct the natural tendency of accountants to keep up forevermore the burden of work having only momentary value.

Use code letters to identify accounts. They are easier to remember than numbers. Have your costs originate with your sub-foremen—not your timekeeper—and let him write out a description of the work each of his few men are doing, if he prefers—the office man can easily insert the appropriate code letters. Have the daily summary of labor costs on the superintendent's desk every morning. Total it each week and turn it in to the general office for comparison with the original estimate, which should conform to the same list of accounts. Make each man personally responsible for the accuracy of his work, but don't burden him with too much detail.

The System Must Be Flexible.—Flexibility of the system may be assured by careful analysis of your first skeletonized list of accounts. Be sure all possible main sub-divisions are accounted for and the expansion and contraction of the detailed subdivisions may be effected readily, without altering the main subdivisions; the comparative costs of which are of real value when extended over a long period.

What Costs Are Used For.—The contractor uses costs for two distinct purposes—to control his operations on the job, and as the basis of future estimates. For the first purpose he must get quick action, and this is readily accomplished, so far as the all important labor costs are concerned by the procedure outlined. Quick material costs, however, cannot be obtained by waiting for the necessarily accurate figures from a carefully audited invoice, but must be compiled immediately from unchecked records. Ultimately, of course, the contractor will get final, accurate material and labor costs upon which he may base later estimates.

This brings up the relation of cost accounting to general accounting. Avoid, wherever possible, entering estimated or inaccurate costs into your permanent records—they must be corrected some time. If you must make such entries—reverse them in toto as soon as they have served their purpose, and let the correct entries follow in due course. Some of the worst complications imaginable come from the effort to continuously adjust estimated figures—such as the value of work in process—in permanent books of record.

The Matter of Overhead.—Then there is the matter of overhead—which some of our competitors do not have to contend with. Estimators never recognize it, or, if they do, they say it can be absorbed readily in savings in buying. If your business should be afflicted with this unnecessary evil, keep the costs under appropriate names and, on your permanent records, let them stay there until the end of the year. If you must distribute this month's overhead over direct costs, do it on scratch paper—because next month you'll change your mind—then you'll still be able to tell from your ledger how much that pretty stenographer is actually costing you. This also applies to depreciation. Adopt a simple, straight line method, and keep to it, in spite of theorists and the Federal Income Tax man.

This is a straight bookkeeping tip. Post your payrolls and material vouchers (summaries of your disbursements to vendors) direct to your cost ledger, and show the quantities or nature of the items therein—then you will never need to go back to your cost ledger for the detailed analysis of any account.

Incorporate as many "internal checks" into your system as possible. They save the necessity for duplication of work by re-checking and are, in fact, self checking safeguards. For example—prove the accuracy of your timekeeper by an independent check of his daily work against the labor distribution of your sub-foremen.

Engineers dote on graphs and charts. Accountants don't. Executives generally are prone to impatience at the volume of orderly detail necessary to attain their—to them—moderate requirements. Accounts, by nature and training, are pettifogging, mulish, and slightly ossified. If the boss wants his records written in hieroglyphics or sandstone—the accountant should do it that way—but see that the results conform to standard accounting practice.

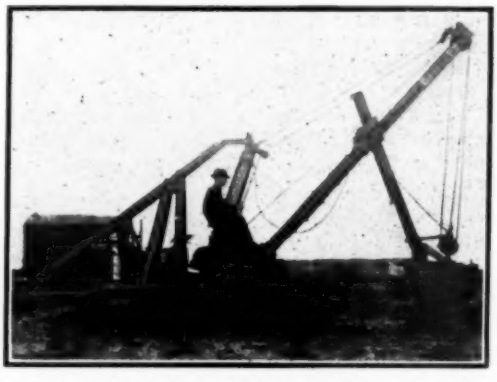
In your discussions on cost problems, remember that no engineer would ever make a good accountant, and no good accountant would ever be an engineer. There must be some reason for this basic difference in the natures of men.

New Tractor Shovel

The Bay City tractor shovel, manufactured by the Bay City Dredge Works, of Bay City, Mich., is being announced to the public following a period of exhaustive and severe tests. It was designed by John W. Fairbanks, who has previously developed earlier models of tractor shovels.

This machine is built around the International McCormick-Deering tractor, which supplies the motive power and provides three propelling speeds—the fastest of which is 3½ miles an hour—through its selective transmission. All of the operating machinery is located on a revolving bull-wheel, which is above the machinery frame. The operator revolves with the machinery, which swings through an arc of 270 degrees. The shovel can dig or load opposite the rear end of the crawlers. The machine is built throughout of special steels with alloy shafting, forged, heat-treated and machine-cut gears and Timken roller bearings. It is equipped with a shovel that will make five bucket trips per minute, and with full length steel crawler treads 9-ft. long, with tread rollers enclosed to keep out dirt. The operating machinery, gears and bearings, are also enclosed under a removable metal hood for protection from weather and dirt.

The machinery is strictly one-man operated, and can be run on kerosene if desired. The shovel boom is 15-ft. long, permitting the shovel to cut at a height of 17-ft., or dump at a height of 15-ft. Crowding is accomplished by means of a steel worm and bronze worm gear running in oil and connected with the machine by shafts and gears. This crowd is reversible and positively self-locking. The Bay City tractor shovel can be quickly converted into a crane, dragline or backfiller, by removing the shovel boom and crowd and putting on a 25-ft. crane boom. Power boom hoist mechanism is provided for either shovel or crane.



Bay City Tractor Shovel Showing Full Length Crawlers with Fully Enclosed Rollers

The dipper capacity is ⅜ cu. yds., water level measure, or practically ½ yd. heaped. The machine weighs 8 tons and is capable of digging very hard material. Present optional bucket equipment includes shovel, clamshell or backfiller scraper.

The Bay City tractor shovel will be sold and serviced by International Harvester Co. branch houses, as well as by Bay City Dredge Works representatives.

The Model 16-B ¾-yd. convertible excavator, featured with skimmer and ditcher buckets, will still be manufactured by the Bay City Dredge Works. The tractor shovel has been developed to provide a smaller machine for smaller jobs.

Municipal Air Field at Milwaukee.—The county board of Milwaukee County, Wis., is arranging to expend $135,000 for the purchase of 163 acres of land to be used for a municipal air field.

Wages of Street Labor, Chicago, from 1913 to 1926

The Bureau of Streets of the Department of Public Works of Chicago, is in charge of the maintenance of 2,450 miles of paved streets and 712 miles of paved alleys. In 1925 the average cost of pavement repairs made with funds from the vehicle tax, was 11 per cent lower than in 1924. This is an excellent showing, particularly in view of the fact that the wages of employees of the bureau have increased 121 per cent in the period 1913 to 1926. The following chart from the report of Joseph J. Butler, assistant superintendent of streets in charge of street repairs shows the wages by years for the different classes of labor employed on street repairs.

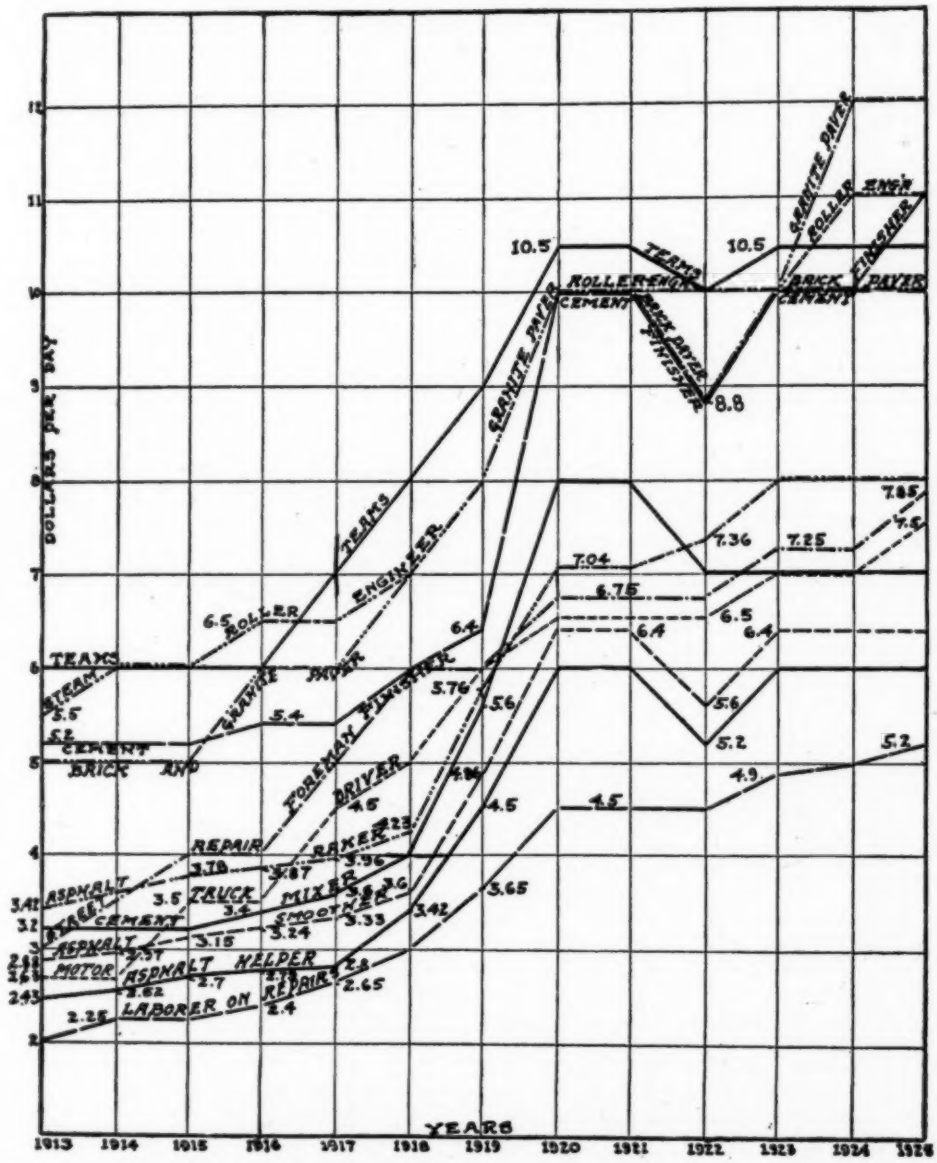


Chart Showing Rate of Wages per 8-Hours for Various Classes of Labor on Street Repair Work

New Trade Publications

The following trade publications of interest to highway officials, engineers and contractors have been issued recently. Copies of them can be obtained by addressing the firms mentioned:

Gas Engine Lubrication.—The Climax Engineering Co., Clinton, Ia., is distributing a revised edition of its "Lubrication Instructions for Climax Trustworthy Engines," a treatise on the subject of proper lubrication of heavy-duty, medium-speed industrial engines. The book was originally prepared by the technical staff of the Vacuum Oil Co. in collaboration with the engineers of the Climax Engineering Co. It has been brought up-to-date and amplified. It contains a large amount of information dealing with lubrication of Climax engines in all classes of service, together with recommendations of proper lubricants and directions as to their use. The book is well illustrated, with diagrams and halftones.

Lime in Earth Road Construction and Maintenance.—The National Lime Association, 918 G St., N. W., Washington, D. C., has issued a bulletin describing the use of lime in earth road construction and maintenance. It contains descriptions of experimental roads and the results obtained from the use of lime. A table showing the amount of lime required for various conditions is included.

Truck Mounted Mixers.—A line of truck mounted mixers, a new product of the Chain Belt Co. of Milwaukee, manufacturers of Rex high speed mixers and pavers, is described in full in a bulletin recently issued by that company. This bulletin is entitled "Faster Mixing on a Faster Moving Basis" and it features the kinds of work a truck mounted machine can do.

Snow Plows.—The Good Roads Machinery Corporation, Kennett Square, Pa., has just issued a catalog illustrating and describing its complete line of Good Roads Champion snow plows. Complete descriptions of the various plows and their uses are given, and numerous illustrations of snow removal work are included.

Traffic Signals.—The Interflash Signal Corporation, 120 Broadway, New York City, has issued a circular illustrating the various uses of its interflash traffic signal.

Industrial Notes

The Speeder Machinery Corporation, manufacturers of gasoline shovels, cranes and draglines, Fairfield, Ia., announces the appointment of the following equipment distributors as representatives in their respective territories: Thos. Lund Co., Salt Lake City, Utah; M. B. Tyler Co., Springfield, Mass.; Chas J. McCarty & Co., Boston, Mass.; Ellis Brothers, Havana, Cuba; E. C. Hingston Co., Chicago, Ill.

The Mundy Sales Corporation, New York, N. Y., distributors for the J. S. Mundy Hoisting Engine Co., announces the following new exclusive distributors for the entire Mundy line: Bacon Engineering Sales Co., 251 Erie Bldg., Cleveland, O.; Barnett-Dunning, Inc., 143 E. Ohio St., Indianapolis, Ind.; Toledo Sales & Engine Co., 16 No. St. Clair St., Toledo, O.

The Adamson Fordson Locomotive, formerly manufactured by the Adamson Locomotive Co., Birmingham, Ala., is now being manufactured and sold by the Atlas Machinery & Supply Co., Birmingham, Ala.

Chain Belt Co., Milwaukee, has started work on a new engineering building at its West Milwaukee Works. The building will house the steel fabricating and assembly departments, drafting room, and general engineering officers of the contract division of its business. This is the third major unit to be erected on the 59 acre West Milwaukee site, and is part of the general plan to gradually move the downtown Milwaukee Plant, located at 16 Ave. and Part St., to the larger tract in West Milwaukee. When the engineering building is completed approximately half of the organization will be located at the West Milwaukee works. The new unit will be of steel, brick, and glass construction with approximately 80 per cent of the roof and walls in glass. Approximately 240 tons of steel are included in the specification. It will be 308 ft. long and 120 ft. wide with the exception of the office building which will be 144 ft. wide. Frank B. Chase, Inc., Chicago, are the engineers and designers. The new building is to be equipped with every modern convenience and will have eight traveling cranes. Several new and larger machines are being added to the present equipment. The building will be devoted exclusively to the manufacture of contract engineering work, such as conveyors, elevators, traveling water screens, bunkers, hoppers, and general steel structural work. Every department connected with that part of the company's business will be housed in the new building, making it a self-contained unit in every sense.

The Sullivan Machinery Co., Chicago, Ill., announces the appointment of J. E. M. Schultz, as manager of its office in Dallas, Texas, to take the place of D. H. Hunter, who has resigned. Mr. Schultz has had a long experience with the Sullivan Co., having been associated with its office at Knoxville, Tenn., in charge of business in North and South Carolina, Georgia, and Florida. The Sullivan office at Dallas is at 523 Santa Fe Building. A warehouse and service station are maintained at the same address.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUG. 24, 1912

Of ROADS AND STREETS, published monthly at Chicago, Illinois, for October 1, 1926.

STATE OF ILLINOIS, } ss.
COUNTY OF COOK, }

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared H. P. GILLETTE, who, having been duly sworn according to law, deposes and says that he is the business manager of the ROADS AND STREETS, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher ENGINEERING & CONTRACTING PUB. CO., 221 East 20th St., Chicago, Ill. Editor, C. T. MURRAY, 221 East 20th St., Chicago, Ill. Managing Editor, H. P. GILLETTE, 221 East 20th St., Chicago, Ill. Business Manager, H. P. GILLETTE, 221 East 20th St., Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

ENGINEERING & CONTRACTING PUB. CO., 221 East 20th St., Chicago, Ill. H. P. GILLETTE, 221 East 20th St., Chicago, Ill. R. W. HUME, 221 East 20th St., Chicago, Ill. E. S. GILLETTE, 221 East 20th St., Chicago, Ill.

COMMONWEALTH TITLE INS. & TRUST CO., Chestnut & Twelfth St., Philadelphia, Pa. LAVERNE LOUER, Ambassador Hotel, Chicago, Ill. WINIFRED GILLETTE, Edgewater Beach Hotel, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

4. That the two paragraphs next above, giving the names of the owners, stockholders, and securitity holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is: (This information is required from daily publications only.)

H. P. GILLETTE, *Business Manager.*

Sworn to and subscribed before me this 24th day of September, 1926.

KITTIE C. WOULFE, Notary Public.

(My commission expires February 9th, 1930.)

[Seal]